

# MONTHLY WEATHER REVIEW,

## JANUARY, 1879.

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

### INTRODUCTION.

In compiling the present REVIEW the following data, received up to February 14th, have been made use of, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 119 Signal Service stations and 11 Canadian stations, as telegraphed to this office; monthly journals and means, 121 and 144 respectively, from the former, and monthly means from 12 of the latter; reports from 21 special Sunset stations; 243 monthly registers from Voluntary Observers; 52 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from Voluntary Observers and the local Weather Services of the States of Iowa and Missouri; reliable newspaper extracts; special reports.

### BAROMETRIC PRESSURE.

Upon chart No. II is exhibited by the isobaric lines the general distribution of the atmospheric pressure, as reduced to sea-level, for the month. Compared with the means for January of previous years, the pressure is above the normal on the Pacific coast and from Wyoming and New Mexico to the Lower Ohio valley, and thence to the Gulf of Mexico and southern portion of the South Atlantic States. Over Lake Superior and from the Lower Lakes to North Carolina and thence northeastward it has been below the normal, especially over New England, the deficiency gradually increasing to Maine, where, at Portland, the mean pressure is 0.16 inch below the normal.

*The Local Barometric Ranges* for the month, as reduced to sea-level, have been largest over New England, and from Dakota and Minnesota to Kansas. Taken by districts they vary as follows:—New England, from 1.83 at Eastport, to 1.19 at New Haven; summit of Mt. Washington, 1.26; Middle Atlantic States, 1.25 at Philadelphia to 1.02 at Lynchburg; South Atlantic States, 1.00 at Charlotte to 0.64 at Jacksonville; Lake region, 0.87 at Chicago to 1.16 at Oswego and 1.35 at Duluth; Ohio valley and Tennessee, 1.09 at Morgantown, and 1.13 at Knoxville to 0.76 at Nashville; Gulf States, 0.37 at Key West to 1.00 at Corsicana and 1.14 Brackettville; the Northwest and Eastern slope of the Rocky mountains, 0.98 at St. Louis to 1.10 at Fort Sill, 1.48 at North Platte, 1.57 at Yankton and 1.71 at Pembina; Rocky mountain stations, 0.71 at Santa Fe to 0.83 at Denver; summit of Pikes Peak, 0.63; Western Plateau, 0.81 at Pioche to 1.01 at Boise City; Pacific coast, 0.41 at Campo, and 0.52 at San Diego to 1.13 at Portland, Or.

*Areas of High Barometer.*—Eleven are described below. Four of them, namely: Nos. I, II, V and VI, deserve special notice as they produced the minimum temperatures of the month over the regions traversed by them.

No. I.—This area, which was over the northwest territory of British America during the 1st and 2d of January, moved slowly south and east over the United States from the 3d to the 7th, and over the Bermudas on the 8th. A telegraphic dispatch received at St. Paul, Minn., January 3d, reported the following low temperatures in British America: —60° at Battlefield, the capital of the Northwest Territory; —35° at Ft. Pelly, and —29° at Winnipeg. The lowest temperatures recorded over the United States, (Signal Service observations,) were: over the Northwest, —32° at Pembina on the 1st and at Breckenridge on the 2d; in the Mississippi valley, —26.°2 at St. Paul and La Crosse on the 2d, to 20° at New Orleans on the 6th; in the Atlantic States, —5° at Fort Whipple, Va., on the 3d, to 25° at Jacksonville, Fla., on the 7th; and at Prospect, Bermudas, 45.°5 on the 8th. On the 1st the pressure rose west of the Mississippi, and on the morning of this day the isotherm of zero curved through Wisconsin, Nebraska, Colorado and Idaho. 2d, the pressure continued highest over the Northwest, and rising thence to the Gulf, South and Middle Atlantic

coasts and Lower Lake region; the morning isotherm of zero curved through Michigan, Indiana, Missouri, Colorado, Wyoming and western Montana. 3d, the highest pressure extended from Minnesota to Missouri, and the morning isotherm of zero curved through Michigan, New York, Connecticut, Virginia, Tennessee, Indian Territory, Colorado and Montana; the lowest temperature ( $-29^{\circ}$ ) was reported at Bismarck. 4th, the region of highest pressure remained almost stationary and the temperature generally rose slightly. The morning isotherm of zero curved south over Lake Michigan, thence east to Pennsylvania and westward through Tennessee, Arkansas, Colorado and western Dakota. The lowest temperature ( $-30^{\circ}$ ) occurred at Yankton. 5th, the region of highest pressure continued almost stationary until evening, when the pressure fell rapidly over the Northwest and the maximum was transferred to the Southwest. The lowest morning temperature ( $-29^{\circ}$ ) occurred at Bismarck, but a rapid rise occurred over this region during the day; the morning isotherm of zero curved through Wisconsin, thence to Pennsylvania and westward through Kentucky, Missouri, Kansas, Nebraska and western Dakota. 6th, the highest pressures extended from the Ohio valley to the Gulf of Mexico, over which region the morning minimum temperatures ranged from  $2^{\circ}$  at Knoxville to  $22^{\circ}$  at St. Marks; the temperature still remaining below zero from Indiana and Indian Territory to Minnesota. 7th, the highest pressure moved over the South and Middle Atlantic States, the minimum morning temperatures ranging from  $12^{\circ}$  at Washington and Charlotte to  $27^{\circ}$  at Savannah; the temperature was everywhere above zero. 8th, highest pressure probably passed eastward, over or near the Bermudas, where the minimum morning temperature was  $45.5^{\circ}$ . High northeast to northwest winds preceded this area, and Cautionary Off-shore Signals were ordered up along the Gulf coast at midnight of the 1st and morning of the 2d, and were justified by the following velocities: Indianola, NE. 36, Galveston, N. 25, and St. Marks, NW. 28. Along the Atlantic coast the Signals hoisted on the 1st for storm No. II were changed to Cautionary Off-shore on the 2d, and the velocities are noticed under that storm, as also, the high winds and severe snow-storms in the Lake region. The continued northwesterly winds along the Atlantic coast produced very low tides, and the observer at Baltimore reported the lowest tide on record at that place, on the 4th and 5th, during which several steamships and other vessels grounded in the channel. As some of the results of the extreme cold, the following items may be of interest: deaths from freezing were reported at Wilksbarre, Pa., Fort Wayne and Vincennes, Ind., Leavenworth, Kan., Chicago, Ill., near Rockport, Copiah Co., and in Lincoln Co., Miss.; all the locomotives on the Dakota Southern and New York city elevated railroads were disabled by freezing; river navigation was suspended at Cairo, where the ice in the Ohio extended from shore to shore, and at Memphis it was seriously interfered with by heavy floating ice filling the river from bank to bank and by the landings being ice-bound.

No. II.—The pressure gradually increased over Washington Territory and Oregon, from the 1st to the 7th, and clear or fair weather, with cool northerly winds prevailed on the Pacific coast during these days, excepting the rains of the 1st and 2d, attending low area No. I. On the 7th the pressure reached the maximum at Portland, Or., and high northerly winds prevailed over California and Nevada. At Mare Island, Cal., high northwest winds continued from 9 a. m., to 4 p. m., with an average velocity of 39 miles per hour. The following velocities were also recorded at Signal Service stations: San Francisco, NE. 40; San Diego, N. 28; Sacramento, N. 33; Winnemucca, (on the 6th,) NW. 40; Pioche, N. 32. 8th, highest pressures over California, with light winds and calms, and clear, cool weather.

No. III.—During the 8th the pressure rose over the Eastern slope, and northerly winds, with sleet and snow prevailed over the Southwest. 9th, this area extended from the Gulf to the Lakes, and on the 10th moved off the Atlantic coast, with increasing pressure. 11th and 12th, it passed eastward over the Bermudas.

No. IV.—This area moved in rear of low area No. V. It appeared on the Pacific coast on the 10th and probably extended from Arizona to Texas on the 11th. On the 12th and 13th it was over the Gulf States, with diminishing pressure. Cautionary Off-shore Signals were ordered along the Gulf coast on the 11th and the following maximum velocities recorded on the 12th: Indianola, N. 31, Galveston, W. 36, and St. Marks, NW. 28.

No. V.—was over Manitoba on the 14th, and on the 15th moved eastward north of the Lake region to New England. The minimum temperatures on the morning of the 15th, at Saugeen and Rockliffe, were  $-26^{\circ}$  and  $-27^{\circ}$ , respectively. On the morning of the 16th it was over Maine and lower Canada, while low area No. VIII was over the Lower Lakes.

No. VI.—appeared over Oregon and Washington Territory on the 14th, and remained on the Pacific coast until the 18th, accompanied by generally clear and cool weather. On the morning of the 16th the following minimum temperatures of the month were recorded:—Los Angeles,  $36^{\circ}$ ; San Diego,  $35^{\circ}$ ; Red Bluff,  $27^{\circ}$ ; and Sacramento,  $29^{\circ}$ . 18th, this area extended eastward over the Western plateau, Rocky Mountain region and Eastern slope, and during the day the minimum temperature of the month ( $-33^{\circ}$ ) was recorded at the summit of Pikes Peak. 19th, it extended from the Rocky mountains to the Southwest. 20th, covered the Gulf of Mexico and on the 21st passed eastward over Florida.

No. VII.—developed during the 16th over the Eastern slope, in rear of low area No. VIII and by 11 p. m. had moved into the Ohio valley. 17th, passed over the Middle Atlantic States and New England.

No. VIII.—developed over the Eastern slope on the 22nd, in rear of low pressure area No. XII. 23rd, moved into the Ohio valley and on the morning of the 24th covered the Atlantic States.

No. IX.—appeared over the Northwest, in rear of low area No. XIII, on the morning of the 25th and moved eastward during the day to the Lake region. 26th and 27th passed southeast off the Atlantic coast.

No. X—developed over the Upper Mississippi valley and Lake region on the 28th, in rear of low area No. XIV. It was probably dissipated on the 30th while over the Lower Lake region.

No. XI—appeared over the Northwest on the 29th where it remained central until the 31st.

*Areas of Low Barometer.*—Fifteen are described and the tracks of eleven centres are shown on chart No. I. Five had their origin west of the Rocky mountains, three of which (Nos. IV, V and VIII) followed very similar paths, namely, southeastward over the Western Plateau to the Southwest, and thence northeastward over the eastern section of the United States, during the first half of the month; the other two (Nos. XIII and XIV) passed eastward along the northern boundary, and were instrumental in producing the southerly winds and high temperatures of the latter half of the month. From the small table at the lower left-hand corner of the chart it will be seen that the storm-centres of the present month have moved with unusual rapidity across the country, and a study of the International Charts shows that some, at least, continued to move rapidly eastward after leaving the Atlantic sea-board. This is in strong contrast to the storm-centres of November and first half of December, during which period the average velocity of storm-centres across the land was much slower.

No. I—is an area of low pressure which existed during the last few days of December, and continued during the 1st of January, central off the California coast. It produced heavy rains along the coast from Santa Barbara to Los Angeles on the 31st, and a waterspout, which was first observed on the ocean, passed northeastward up the valley of Mission creek, during considerable damage. The observer at Santa Barbara reports 1st, 12:15 a. m., to 3:45 p. m., heavy east wind, one man killed by falling chimney. Considerable damage to wharf, wind-mills, fences, shade trees and houses. At Mare Island, Cal., an easterly gale prevailed from 5 a. m. to 9 p. m. of January 1st, with an average force of 44 miles per hour. The track of this centre is not charted.

No. II.—On December 31st, as an area of high pressure was moving eastward off the Atlantic coast, a centre of low pressure apparently developed over the Gulf of Mexico, which moved, *January 1st*, northeastward to North Carolina, accompanied by light rains and winds. On the 1st the pressure also fell in the Lake Region, and by night a depression was central north of Lake Huron, with increasing westerly winds and snow over Lake Michigan and Illinois, in advance of high pressure area No. I, the weather accompanying which latter area was to prove the most notable meteorological feature of the month. 2nd, the centre moved rapidly eastward to New England, and, joining the one from the Gulf, quickly developed into a severe storm; at 11 p. m. the pressure was lowest at Eastport, where the barometer read 28.82, or 1.18 in. below normal. At this station and at Quebec a severe easterly gale, with snow, prevailed; on the summit of Mt. Washington the wind was NW. 84 miles, heavy snow; and thence over the Lake region and Middle States a steep barometric gradient existed, with brisk to high westerly winds and rapidly falling temperature. 3rd, the centre moved very slowly eastward over eastern Maine, the pressure at Eastport remaining throughout the day about 28.55, or about 1.45 in. below normal; the lowest reading, 28.49, or 1.51 below, occurred at 2 p. m., January 3rd, after which time the wind changed from S. to NW. Light winds prevailed in the Canadian Maritime Provinces, but over New England, the Middle States and Lower Lake region very cold and high westerly winds and gales attended the steep barometric gradient. 4th, the centre passed eastward over Nova Scotia, the lowest pressure (apparently about 28.50, or 1.50 in. below normal) occurring at Halifax before the 7:35 a. m. observation, at which time the wind had changed to N. Light winds and calms prevailed over the Canadian Maritime Provinces and brisk westerly winds over New England. The barometric gradient over the Lower Lake region and Middle States continued very steep during the daytime, with high westerly winds and gales, but diminished after sunset with decreasing winds. Snow continued on the 5th in the Lower Lake region, but with diminished winds and higher temperatures. Although the measured quantities of snow were quite moderate, except at Rochester on the 3d and 4th, when 2.31 inches, melted snow, were recorded, it was so badly drifted by the attending high winds as to seriously impede railroad communication, and traffic on the lines along the lake shores east of Cleveland was almost entirely suspended for several days. Cautionary Signals were ordered at midnight of the 1st from Cape Lookout to Sandy Hook, which were changed to Cautionary Off-shore on the 2d, and at Milwaukee, Grand Haven and Ludington; and on the morning of the 2d along the New England coast, which were changed to Off-shore during the afternoon. These Signals were all justified, and the following (measured) high wind velocities were recorded: On the 2d, Milwaukee, W., 41; Oswego, W., 40; Morgantown, W., 42; Grand Haven, NW., 41; Eastport, E., 60; Boston, W., 40; Wood's Holl, NW, 62; Sandy Hook, W., 72. 3rd, Buffalo, SW., 47; Newport, W., 48; Barnegat, W., 48. 4th, Cape Lookout, NW., 44; Cape May, W. and NW., 60; Philadelphia, W. 48. For the progress of this storm over the Atlantic ocean attention is called to the chapter on International Meteorology.

No. III.—As high pressure area No. I. moved southward along the eastern slope of the Rocky Mountains on the 6th the pressure fell rapidly from Manitoba to Utah, with snow during latter part of day. At 4.35 p. m., the barometer at Pembina had fallen to 29.59 or 0.53 in. below normal, after which it commenced rising, and a secondary depression (low area No. IV.) formed over Utah. 7th, centre moved eastward north of the Upper Lakes, with southerly to westerly winds and light snows thence to the Ohio valley. 8th, moved eastward over Quebec, and southwesterly winds, cloudy and rainy or snowy weather prevailed, thence to Michigan, the Ohio valley, Middle States, New England, Nova Scotia and Cape Breton. 9th, it probably passed northeast over Labrador, but as its entire path was to the north of our stations it is not

charted. Cautionary Signals were ordered up at midnight of the 6th at Milwaukee, Grand Haven and Ludington, which were justified, although late at Milwaukee.

No. IV—developed over the western Plateau in the southwest quadrant of preceding area, during the latter part of the 6th. 7th., at 7.35 a. m. and 4.35 p. m. it was central over New Mexico, the barometer at Santa Fe reading about 29.47 or 0.26 below normal; southerly winds, cloud and rain prevailed over southern portion of Arizona and from Texas to the Lower Mississippi valley, and brisk to high northerly winds and snow from Nebraska to Utah and northern portions of Arizona and New Mexico; at Fillmore, Utah, seven inches of snow fell on the 6th and 7th. At 11 p. m., the centre was transferred to the Lower Rio Grande valley, and northerly winds and snow extended to southern portions of Arizona and New Mexico. 8th, moved northeast over the Gulf States, followed by northerly winds, increasing to gales along the coast, snow, sleet and rain in the Southwest, and accompanied over the interior of the Gulf States and Tennessee by heavy rains. 9th, moved rapidly northeast and at 11 p. m., was central between Capes Cod and Sable; east to south winds and heavy rains prevailed from eastern Tennessee to New Jersey, and northerly winds, with heavy snows from West Virginia to New England, thus creating a second snow blockade, or rather prolonging that which attended area No. II; at 11 p. m., high northwest winds and gales prevailed along the coast from North Carolina to Maine. 10th, the centre moved rapidly northeastward and its further history will be noted under International Meteorology. Cautionary Signals were ordered at Indianola and Galveston at midnight of the 6th, changed to Off-Shore midnight of the 7th; at Mobile and St. Marks at midnight of the 8th, changed to Off-Shore, morning of the 9th; from Savannah to Macon, morning of the 9th, from Cape Lookout to Wood's Holl, morning of the 8th and from Boston to Eastport, afternoon of the 9th; those along the Atlantic coast were changed to Off-Shore, on the afternoon of the 9th. All signals were justified. The following maximum velocities were recorded:—on the 8th, at Indianola, N., 54; Galveston, NW., 40; on the 9th, Wilmington and Capes Lookout and Hatteras, SW., 44; Cape May, NW., 56; New York, NW., 40; on the 10th, Sandy Hook, NW., 56; Wood's Holl, NW., 48; Mt. Washington, NW., 81.

No. V.—During the 8th the pressure fell rapidly from Washington Territory and Oregon to western Montana, with rain and snow gradually extending southward; over five inches of snow fell at New Westminster, Brit. Col., and at Yreka, Cal. 9th, the depression moved southward over the Western plateau, and by 11 p. m., was over Utah. Rain or snow, followed by clear or fair weather, prevailed from Idaho to northern California; from four to five inches of snow was reported at three stations in Nevada, and southerly winds, with rising temperature, over the Eastern slope. 10th, moved slowly southeast and by 11 p. m., was over northwestern Texas; rapidly falling temperature with snow, prevailed in eastern Arizona and southern New Mexico and south to east winds, increasing cloudiness, and, by night, a general light rain from Indian Territory to the West Gulf coast. 11th, at 7:35 a. m., the lowest pressure was over southern Texas; rain prevailed from Texas to Mississippi and heavy snow from Indian Territory to Cairo. During the day, it moved northeast to Alabama, with heavy rains in its northern quadrant from Louisiana to Tennessee. 12th, moved eastward off the North Carolina coast, where a severe gale prevailed at night, and was accompanied by heavy rains from Georgia and east Tennessee to Virginia. These rains, together with those of the 8th and 9th, accompanying area No. IV, resulted in heavy freshets in the rivers of this section; much damage occurred on those rivers which were ice-gorged, especially those of eastern Tennessee. 13th, the depression passed north of Bermuda, as shown on chart No. I, after which it has not been traced. Cautionary Signals were ordered on the 11th from Charleston to Sandy Hook, which were all justified; and on the morning of the 12th, from New York to Wood's Holl, which latter were only justified within 100 miles of Sandy Hook. Maximum velocities on the 12th: Charleston, SW., 30; Wilmington, SW., 32; Cape Lookout, NW., 40; Kittyhawk, N., 63; Cape Henry, NE., 52; along the New Jersey coast, the highest winds were NE., brisk.

No. VI passed eastward on the 9th north of Minnesota, where southerly winds and light snow prevailed.

No. VII.—As high pressure area No. IV moved southward on the 10th over California, in rear of low area No. V, the barometer fell to the northward with increasing precipitation and fresh to brisk southerly winds, and at 11 p. m., the lowest pressure was probably central on the coast of Washington Territory; at 4 p. m., a heavy SE gale prevailed over the Gulf of Georgia, while northeasterly winds were reported at Victoria, V. I., and New Westminster and Lytton, British Columbia. 11th, the lowest pressure extended from Oregon to Montana, and rain or snow fell from northern California, where it was heaviest, to Idaho and northward. During the preceding night a southeast gale prevailed in the Sacramento valley—maximum velocity at Red Bluff, SE., 44 miles. 12th.—Higher pressures from Oregon to western Montana. At 7:35 a. m., the lowest pressure was recorded at Bismarck, Dak., (29.77 or 0.33 in below normal), where calm, clear weather prevailed; at 11 p. m., the lowest pressures were recorded at Duluth and Marquette (29.78 or 0.30 below normal). East to north winds and snow prevailed throughout the day in Manitoba, and southerly winds with fair weather in Minnesota. 13th, was north of the Lake region and St. Lawrence valley; heavy snow and brisk to high winds were reported in latter section. Cautionary Signals were ordered up at Milwaukee, Grand Haven and Ludington, on the morning of the 13th in anticipation of increasing westerly winds, but were not justified, possibly because of the advance of area No. VIII.

No. VIII—crossed the United States and probably the Atlantic Ocean. It appeared during the 13th to the north of Washington Territory and Idaho; southerly winds prevailed, with rain on the Pacific coast and snow in Idaho; by night the winds changed to northwest on the coast of Oregon, when the lowest pres-

sure was probably over Idaho. 14th, it moved rapidly southward to Arizona as a heavy storm; heavy snows and brisk southerly, changing to northerly, winds prevailed over the *Western Plateaus*, and rain or snow followed by clear weather in northern California; at St. George, in southern Utah, a smart shower was reported after 9 p. m., and heavy rain fell in southern New Mexico during latter part of day. 15th, moved rapidly northeast to Illinois, preceded by easterly winds, increasing cloudiness and, by evening, rain or snow from Tennessee to the Lake Region and Middle Atlantic States. Heavy snow fell from Kansas to Lake Michigan. 16th, it moved rapidly eastward and by 4:35 p. m. the centre was off Long Island. North of the centre, namely, from the Lower Lakes to New England, cold northerly winds and heavy snow prevailed, but at the immediate centre, and thence southward, high temperatures, southerly winds and rain. The following temperatures were recorded at 7:35 a. m.: at Louisville and Cincinnati, 41°; Pittsburg, 42°; Erie, 38°; Buffalo, 16°; Rochester, 12° and Albany —1°. At 11 p. m., northwest winds and clear, cool weather prevailed throughout the Atlantic States, in advance of high area No. VII. Cautionary Signals were ordered up on the morning of the 15th at Milwaukee, Grand Haven, Ludington and along the Atlantic coast from North Carolina to New Jersey; at 11 p. m. from New York to Wood's Holl, and, on the morning of the 16th, thence to Eastport. They were justified, except at Cape Henry, Norfolk, Portland and Eastport. The maximum velocities were: Milwaukee, E., 36; Cape Lookout, N.E., 36; Cape May, N., 28; Sandy Hook, E., 36; and Wood's Holl, N.W., 32.

No. IX—was central north of the Lake region on the 17th. A barometric depression extended thence to the Gulf, over which region snow or rain prevailed. The precipitation was heaviest from central Texas to Missouri and Tennessee, and the map of departures from the normal show the formation of a new centre of depression, which will be described as area No. X. 18th, the present centre of depression moved eastward to the Gulf of St. Lawrence, and southerly winds, with snow or rain, prevailed over the Atlantic States. At 11 p. m., the wind had veered to northwest, with clear weather over the Middle States and New England. No signals were ordered for this disturbance.

No. X.—As stated above, this centre probably formed in the southern extremity of the former depression. During the 18th, it was over the South Atlantic States, where cloudy and rainy weather prevailed. 19th, it moved northeast off the coast with increasing energy. 20th, passed eastward south of Nova Scotia and Cape Breton; the pressure at Sydney falling to 29.00, or about 0.96 in. below normal. Cautionary Off-shore Signals were ordered up on the morning of the 19th from Smithville, N. C., to Sandy Hook, which were justified on the 20th by the following maximum velocities: Wilmington, N.W., 33; Cape Lookout, N.W., 41; Kittyhawk, N., 50; Cape Henry and Cape May, N.W., 56; and Sandy Hook, N.W., 34. As the centre passed south of Nova Scotia it was attended by brisk to high northeast, backing to northwest, winds; and hard gales were reported in 41° N., 58° W.

No. XI—was central on the 21st north of the Lakes, in which region light snow prevailed, extending by night to New England. 22nd, passed east over Maine and Nova Scotia, with heavy snow and fresh to brisk winds. Cautionary Signals were ordered from North Carolina to Maine, and the following maximum velocities recorded: Kittyhawk, S. 26; Cape Henry, S.E. 28; Cape May, S. 36; and Wood's Holl, S.W. 36.

No. XII—was central over Iowa on the morning of the 22d, having developed in the southwest quadrant of the preceding area. During the day it moved eastward accompanied by cloudy or fair weather, and by rising temperature south of the centre; at 11 p. m. it was central over Lake Erie and light rain or snow prevailed thence to Vermont and Ontario. 23d, passed over New England and Nova Scotia with sleet or snow over the Canadian Provinces and Maine, but followed by clear weather by night. Cautionary Signals were ordered up on the afternoon of the 22d on the North Carolina and New Jersey coasts, and those ordered up along the New England coast in advance of the preceding area were continued. The following maximum velocities were recorded: Cape Hatteras, S.W., 27; Cape May, S.W., 28; Sandy Hook N.W., 36, and Eastport, N.W., 29.

No. XIII.—This area appeared over Oregon and Washington Territory during the latter part of the 22nd, and passing eastward along the northern boundary of the United States, during the 23rd, 24th and 25th, produced southerly winds and high temperatures over the entire country during these days. Heavy rains and occasionally high southerly winds prevailed on the Pacific coast during the 23rd. 24th, the centre moved rapidly eastward to north of the Lake region. Light rains continued from the Pacific coast to Utah and Montana, and at many stations thence to the Lake region the maximum temperatures of the month occurred. On the Western Plateau the following temperatures were recorded: —at Winnemucca, 55°, Salt Lake City, 54°, and on the summit of Pikes' Peak, 30°; and the observer at Austin, Nev., described the rain-fall at that place as being very unusual at this season. 25th, the centre passed over New England, with sleet or snow from Maine northward, and warm southwest winds and clear or fair weather southward, but followed at night over the Middle States and New England by brisk to high northwest winds and rapidly falling temperature. Cautionary Off-shore Signals were ordered up on the afternoon of the 25th from North Carolina to Maine, which were all justified. Maximum velocities: Cape Hatteras, N.W. 48; Kittyhawk, N. 50; Cape Henry, N.W. 48; Cape May, N.W. 52; Sandy Hook, N.W. 61; Newport, N.W. 50; Wood's Holl, N.W. 64; Boston, N.W. 50; and Eastport, N.W. 36.

No. XIV—developed on the 25th over the *Western Plateaus*, over which region the high temperatures of the preceding day continued, with cloudy and rainy weather. At 11 p. m. the barometer at Salt Lake City read 29.53, or 0.49 below the normal, having fallen 0.48 in. since the preceding 11 p. m. report. 26th,

lowest pressure moved rapidly over Montana and Dakota to Manitoba, accompanied by light snow or rain and brisk southerly backing to brisk and high northwest winds. Southerly winds and high temperatures prevailed from the Rocky Mountains and the Northwest to the Gulf coast, with clear or fair weather, except in the Southwest, where increasing cloudiness and rain was reported. A heavy thunder-storm occurred at San Antonio from 5 to 6 p. m., and commenced at Corsicana at 7:20 p. m. A tornado is reported to have passed over the town of Lockhart, Texas, at 9 p. m., which destroyed forty houses, killed one child and injured several persons. 27th, was central north of the Lake region and warm southerly winds, cloudy and rainy weather prevailed thence to the Gulf coast and New England; during the latter part of day, clearing or clear weather west of the Mississippi and over the Upper Lakes. 28th, centre passed over Maine and Nova Scotia; southerly to westerly winds and high temperatures continued over the Gulf and Atlantic States, with partly cloudy weather and occasional light rain. In the Lake region and Ohio valley the winds changed to west and north, where the temperature fell about ten degrees. From the 29th to the 31st the pressure continued low and falling over the Canadian Maritime Provinces, with northwesterly winds and occasional light snows. Cautionary Signals were ordered up at Milwaukee, Grand Haven and Ludington on the morning of the 26th; from Cape Hatteras to New York at midnight of the 26th, and along the coast of New England morning of the 27th. These were justified at most stations, the following velocities being recorded: Milwaukee, S.E., 30; Grand Haven, —, 32; Alpena, S., 36; Cape May, S.W., 30; Wood's Holl, S.W., 44.

No. XV—probably developed over the interior of Texas on the 30th, on which day a tornado is reported to have passed northwestward over a portion of the town of New Braunfels, 30 miles N.E. of San Antonio, by which "several buildings were blown to atoms and heavy weights carried great distances;" the storm-cloud moved from the south and was accompanied by hail. Throughout the whole day southerly winds, with temperatures ranging from 63° (a. m. min.) at Mason to 83° (p. m. max.) at Laredo, prevailed south of the 32d parallel, while north of this line northerly winds, with temperatures ranging from 40° (a. m. min.) at Fort Sill to 49° at Fort Griffin. 31st, the depression passed over the Gulf and South Atlantic States, accompanied by cloudy and rainy weather.

## INTERNATIONAL METEOROLOGY.

On chart No. IV. are shown the probable tracks of storm-centres over the oceans, and in the upper right hand corner will be found an index to the same. The following is a brief account of each storm, with a few items selected from the large mass of data made use of. No. I moved northeast off the west coast of Europe on November 23d and 24th and developed into an extensive area of low pressure, which continued over that continent until the 31st. No. II is a continuation of low pressure area No. VIII described in the December REVIEW, which continued its rapid northeast movement over the Atlantic, where low pressures and stormy weather had prevailed for several days previous. It was encountered on the 28th by steamer "Anchoria" in lat. 45° 46' N. long. 49° 43' W., where the pressure had decreased to 28.60; and on the 29th and 30th by steamer "Austrian," which vessel reports the low pressure of 27.88 at 6 a. m. of the 30th in 53° N. 25° W. At Monach Lighthouse, Inverness, the pressure fell during the 29th and 30th and on the morning of the 31st reached 28.50, wind south; at 1 p. m. the wind "flew round like a shot" to north with rising pressure. It is highly probable the storm-area No. (VI and VII,) described in the *December Review*, passed eastward north of New Foundland on December 25th; was encountered on the 27th in 51° N., 31° W. by steamer Mac Gregor, which vessel reported, "wind blew with terrific force, causing tremendous sea, lost four life-boats, 190 head of cattle and 500 sheep;" and finally joined the present storm-area on the 29th to the northwest of the Irish coast. No. III probably formed in the southwest quadrant of area No. II, developed into a severe storm on January 2nd, central about lat. 50° N., lon. 40° W., and after moving north-northeast disappeared on the 5th. No. IV. is a continuation of low pressure area No. II of the present *Review* and which was probably joined on the 9th by a secondary storm-centre (No. V,) from the southward, after which it moved southeast toward France. No. VI is a continuation of area No. IV of the present *Review*, which closely followed in the path of the preceding area, until it arrived at mid-ocean, after which it passed to the north of the British Isles. No. VII probably formed in the southwest quadrant of the preceding area and moved southeastward to France. *Pacific Ocean*.—An area of very low pressure probably existed and moved somewhat in the direction of track traced on Chart from December 19th to the 24th, but sufficient reports are not yet to hand to justify a fuller report.

## TEMPERATURE OF THE AIR.

The isothermal lines on chart No. II illustrate the general distribution of the temperature of the air for the month. By reference to the table on the left side of the chart, it will be seen that the temperature of the month has been very generally about or below the normal except in the Rio Grande valley, the Missouri valley and at the Rocky Mountain stations, where it has been about one and a half degree above.

*Minimum and Maximum Temperatures*, respectively:—*Maine*—Orono, —21° and 34°; Eastport, —13°, 36°; Portland, 3°, 43°. *New Hampshire*—Mt. Washington, —29°, 26°. *Vermont*—Woodstock, —25°, 51°; Burlington, —12°, 46°. *Massachusetts*—Billerica, —11°, 52°; Boston, 0°, 56°; Springfield, —5°, 52°. *Rhode Island*—Newport, 3°, 44°; Ft. Adams, —4°, 46°. *Connecticut*—Mystic, —16°, 52°; New Haven, 3°, 54°; New London, 0°, 48°. *New York*—Schroon Lake, —33°, 50°; Plattsburg, Bks., —17°, 36°; Buf-

falo, 1°, 43°; Oswego, 1°, 46°; New York City, —3°, 50°. *New Jersey*—Somerville, —11°, 47°; Trenton, 0°, 52°; Princeton, —8°, 49°. *Pennsylvania*—Franklin, —13°, 40°; New Castle, —16°, 47°; Pittsburgh, —11°, 54°; Philadelphia, —3°, 56°. *Delaware*—Dover, 2°, 62°. *Maryland*—Emmittsburg, —10°, 58°; Cumberland, —5°, 52°; Baltimore, 0°, 64°. *District of Columbia*—Washington, —0.5°, 66°. *Virginia*—Wytheville, —6°, 60°; Dover Mines, 8°, 71°; Mt. Solon, —2°, 56°. *West Virginia*—Helvetia, —14°, 60°; Wellsburg, —12°, 48°; Morgantown, —5°, 60°. *North Carolina*—Highlands, —1°, 65°; Wilmington, 19°, 78°; Murphy, 0°, 69°. *South Carolina*—Aiken, 15°, 78°; Charleston, 23°, 80°. *Georgia*—Gainesville, 10°, 72°; St. Marys, 24°, 78°; Augusta, 17°, 79°. *Florida*—Daytona, 30°, 76°; Gulf Hammock, 22°, 83°; Jacksonville, 25°, 80°. *Alabama*—Green Springs, 8°, 74°; Mobile, 15°, 73°; Montgomery, 14°, 75°. *Mississippi*—Vicksburg, 12°, 80°; Fayette, 7°, 76°. *Louisiana*—New Orleans, 20°, 78°; Pt. Pleasant, 10°, 77°; Oka-loosk, 5°, 79°. *Texas*—Gilmer, —1°, 78°; Jacksboro, —2°, 80°; Laredo, 25°, 83°; Austin, 16°, 78°; Gal-veston, 23°, 71°; Corsicana, 4°, 78°. *Ohio*—Jacksonburg, —25°, 58°; Urbana, —23°, 51°; Columbus, —20°, 56°; Cincinnati, —10°, 64°. *Kentucky*—Danville, —12°, 66°; Bowling Green, —8°, 74°; Louisville, —10°, 66°. *Tennessee*—Clarksville, —10°, 70°; Austin, —6°, 76°; Memphis, 6°, 70°. *Arkansas*—Mt. Ida, —9°, 72°. *Michigan*—Detroit, —15°, 44°; Grand Haven, 0°, 43°; Niles, —18°, 47°; Marquette, —6°, 45°. *Indiana*—Arlington, —25°, 57°; Spiceland, —23°, 56°; Indianapolis, —22°, 57°. *Illinois*—Sterling, —28°, 49°; Peoria, —21°, 46°; Mt. Sterling, —22°, 58°; Cairo, —6°, 64°; Chicago, —18°, 49°. *Missouri*—Ashley, —27°, 60°; Pierce City, —16°, 56°; Corning, —23°, 52°; St. Louis, —14°, 59°. *Kansas*—Topeka, —19°, 62°; Holton, —18°, 54°; Leavenworth, —14°, 56°; Dodge City, —9°, 61°. *Wisconsin*—Neilsville, —30°, 38°; Embarrass, —26°, 45°; Milwaukee, —20°, 46°. *Iowa*—Ames, —30°, 38°; Tabor, —22°, 54°; Du-buque, —22°, 46°; Des Moines, —21°, 52°. *Nebraska*—Genoa, —26°, 70°; Plattsmouth, —24°, 60°; Omaha, —22°, 62°. *Indian Territory*—Ft. Sill, —9°, 70°; Ft. Gibson, —5°, 71°. *Minnesota*—Breckenridge, —32°, 47°; Duluth, —28°, 45°; St. Paul, —26°, 49°. *Dakota*—Pembina, —32°, 36°; Bismarck, —29°, 46°; Yank-ton, —30°, 62°; Olivet, —29°, 65°. *Colorado*—Pikes Peak, —33°, 30°; Denver, —10°, 61°; Georgetown, 5°, 62°. *New Mexico*—Santa Fe, —2°, 76°; Ft. Union, —4°, 72°. *Wyoming Territory*—Cheyenne, —15°, 60°; Ft. Fred. Steele, —27°, 55°. *Montana*—Virginia City, —16°, 44°. *Utah*—Salt Lake City, 4°, 54°. *Nevada*—Winnemucca, —14°, 55°; Pioche, 5°, 57°. *Idaho*—Boise City, 3°, 53°. *California*—San Fran-cisco, 40°, 62°; Los Angeles, 36°, 74°; Red Bluff, 27°, 63°; Sacramento, 29°, 63°; Visalia, 24°, 63°. *Oregon*—Portland, 20°, 52°.

*Ranges of Temperature.*—The monthly ranges will appear from an examination of the minima and maxima just given. Greatest daily ranges vary in New England from 24° at Newport to 38° at Burlington; Middle States, 25° at Cape May to 39° at Albany; South Atlantic States, 19° at Cape Lookout to 36° at Atlanta; Gulf States, 20° at Key West to 36° at St. Marks; Ohio valley and Tennessee, 27° at Louisville to 38° at Pittsburgh and 33° at Knoxville; Lake region, 27° at Milwaukee to 41° at Sandusky; the North-west, 23° at Davenport to 56° at Yankton; Rocky Mountain stations, 27° at Virginia City to 44° at Denver and Santa Fe; Western Plateau, 23° at Salt Lake City to 40° at Winnemucca; California, 14° at San Fran-cisco to 32° at San Diego.

*Frost*—has occurred nearly every day over the northern sections of the country; in the interior of the Southern States and Texas, from the 1st to 21st, 24th; along the Gulf coast, 4th to 10th, 12th, 14th and 21st.

*Ice* formed in the Gulf and South Atlantic States and on the Pacific coast as follows: Green Springs, Ala., 3rd, 4th; Mayport, Fla., 4th, misty rain, freezing as it fell, forming fringes of ice along the eaves of buildings a foot in length, branches and twigs of trees covered with a glittering coat of ice, which did not entirely disappear until the morning of the 7th, an extremely unusual occurrence here; Pt. Pleasant, La., 2nd to 7th, 9th, 10th, 19th, 20th; Franklin, N. C., 3rd, skating on pond, ice 3½ to 6 inches thick; Gilmer, Tex., 20th to 22nd; Sacramento, 15th, 16th, 18th to 21st, 30th, 31st; Visalia, Cal., 15th; Stockton, Tex., 5th; Eagle Pass, Tex., 4th, 6th, 9th, 12th, 19th; Decatur, Tex., 6th, battery frozen, 11th, ice on telegraph wire; Indianola, Tex., 6th; New Orleans, La., 5th; St. Marks Fla., 4th to 7th; Mobile, 3rd, 5th, 20th; Jacksonville, 5th.

*Ground Frozen.*—Green Springs, Ala., 20th; Franklin, N. C., 3rd, 12 inches.

## PRECIPITATION.

On chart No. III. is illustrated the general distribution of precipitation for the month. On the left side is a table giving the average precipitation for the month, which shows a large excess over Tennessee; a slight excess in the St. Lawrence Valley, Western Gulf States and California, and elsewhere a general deficiency which is greatest in the East Gulf States and Oregon.

*Special Heavy Rains.*—8th and 9th, Knoxville, Tenn., 3.99 inches; Chattanooga, 3.12 in.; Fayetteville N. C., 6.00 in. 11th and 12th, Dover Mines, Va., 2.50 in.; Chattanooga, 3.31 in.; Gainesville, Ga., 2.77 in.; Murphy, N. C., 3.50 in.; 12th, Weldon, N. C., 2.56 in. 15th, North Lewisburg, Ohio, 4.80 in. 17th, Clarksville, Tenn., 2.40 in. 18th and 19th, Fayetteville, N. C., 2.00 in. 27th and 28th, Margareta, Ohio, 3.70 in.

*Largest Monthly Rain-falls.*—Fayetteville, N. C., 10.25 inches; Knoxville, 9.59; Baton Rouge Bks., La., 9.00; Murphy, N. C., 8.60; Chattanooga, Tenn., (for 23 days,) 8.48; Fort Canby, Wash. Ty., 8.24; Memphis, 7.71; Pt. Pleasant, La., 7.57; Shreveport, 7.31; Mt. Washington, 7.13; Kittyhawk, 6.88; Cor-sicana, 6.72; Clarksville, Tenn., 6.47; Cape Hatteras, 6.44; McMinnville, Tenn., 6.42; Austin, Tenn., 6.38; Vicksburg, 6.18.

*Smallest Monthly Rain-falls.*—Burkes, Ariz., trace; Vail, Ia., and Breckenridge, 0.05 inches; Phoenix, Ariz., and Omaha, 0.07 in.; Fredericksburg, Uvalde and Brackettsville, Tex., 0.08 in.; Ft. Lyon, Cal., and Eagle Pass, Tex., 0.10 in.; St. Paul, Minn., 0.11 in.; Castroville, Tex., and Plattsmouth, Neb., 0.12 in.; Ft. Leavenworth, Kan., 0.14 in.; Wickenburg, Ariz., Bismarck, Emerson and De Soto, Neb., 0.15 in.; Tabor, Ia., 0.19 in.; Ft. Garland, Col., 0.18 in.; Genoa, Neb., Ft. Dodge, Ia., and Camp Verde, Ariz., 0.20 in.; Yankton, Dak., 0.23 in.; Pilot Point, Tex., 0.24 in.; Olivet, Dak., 0.25 in.; Concho, Tex., 0.26 in.; Cheyenne, 0.32 in.

*Floods.*—The only floods reported were occasioned by ice gorges, and are noticed under the head of navigation.

*Hail.*—Denison, Tex., 8th; St. Meinrad, Ind., 15th; Springfield, Mass., 9th; Plattsmouth, Neb., 27th; Princeton, N. J., 8th, 17th, 23rd; Troy, N. Y., 27th; Pikes Peak, 30th; Breckenridge, Minn., 24th; San Antonio, Tex., 26th.

*Rainy Days.*—The number of days on which rain or snow has fallen varies, as follows: New England 7 to 20; Middle States, 7 to 19; South Atlantic States, 5 to 12; Gulf States, 6 to 17; Ohio valley and Tennessee, 14 to 20; Lower Lake region, 10 to 22; Upper Lake region, 8 to 18; Upper Mississippi valley, 4 to 9; Lower Missouri valley, 4 to 7; Eastern slope, 3 to 14; Rocky Mountains, 4 to 10; Western Plateau, 11 to 15; Pacific coast, 8 to 14.

*Cloudy Days.*—For New England, the number varies from 8 to 20; Middle States, 6th to 18th; South Atlantic States 5 to 20; Gulf States, 4 to 21; Ohio valley and Tennessee, 7th to 17th; Lower Lake region, 14 to 25; Upper Lake region, 7 to 21; Upper Mississippi valley, 3 to 12; Lower Missouri valley, 3 to 12; Eastern slope, 5 to 18; Rocky Mountains, 2 to 10; *Western Plateaus*, 6 to 15; Pacific coast, 5 to 10.

*Snow.*—The precipitation northeast, north and west of the Ohio valley, occurred generally as snow. On the Pacific coast, and in the Gulf and South Atlantic States it occurred, as follows: In *British Columbia* on the 5th and 8th. *Oregon*, 15th. *California*, on the coast mountains, 28th, and Sacramento, 13th. *Texas*, 4th, 5th, 6th, 8th to 11th. *Louisiana*, 3rd, 4th, 5th. *Mississippi*, 4th, 5th, 9th. *Alabama*, 4th, 5th. *Georgia*, 4th, 5th. *North Carolina*, 8th, 19th.

*Snow from a cloudless Sky.*—Newbury, Vt., 16th, (6.30 p. m.) sky was perfectly clear and yet for about twenty minutes there was a continuous fall of snow, the flakes were large, but very thin and transparent, sky was sufficiently clear that the zodiacal light shone with considerable brilliancy; Burlington, Vt., 14th, snow fell with sky so clear that stars were plainly visible.

*Depth of snow on Ground at end of Month.*—It varied in depth in the different sections as follows: *New England*, from trace in Connecticut to 36 inches in Maine and on Mt. Washington. *Middle States*, 0 to 3 inches along the coast, to 27 inches in the interior. *Ohio*, 0 to 16 inches. *Lower Lakes*, 0 to 30 inches. *Upper Lakes*, 0 to 18 inches. *Upper Mississippi valley*, 0 to 1 inch. *Illinois*, 3 to 12 inches. *Red river of the North valley*,  $\frac{1}{2}$  to 5 inches. *Missouri*, 4 to 5 inches. *Dakota*, 0 to 1 inch, and snow drifts. *Rocky Mountains*, 0 at Santa Fe to 10 inches at Virginia City. *Western Plateaus*, trace at Winnemucca to 7 inches at Pioche and 4 inches at Salt Lake City.

## RELATIVE HUMIDITY.

The average percentage of relative humidity for the month ranges as follows: New England, 59 to 76; Middle Atlantic States, 63 to 80; South Atlantic States, 65 to 81; East Gulf States, 41 to 80; West Gulf States, 73 to 85; Lower Lakes, 73 to 82; Upper Lakes, 71 to 77; Ohio valley and Tennessee, 62 to 77; Upper Mississippi valley, 69 to 79; Lower Missouri valley, 62 to 76; Red River of the North valley, 85 to 88; Eastern Slope, 61 to 82; Western Plateaus, 60 to 73; California, 64 to 73. *High stations* report the following, not corrected for altitude: Mt. Washington, 85; Pike's Peak, 40; Cheyenne, 61; Virginia City, 63; Denver, 52; Santa Fe, 55.

## WINDS.

The prevailing winds at the Signal Service stations are shown by arrows on chart No. II, from an examination of which it will be seen that the prevailing winds of the month were very generally from north to west, except along the Gulf coast and in central Texas, where they were southerly.

*Total Movements of the Air.*—The following are the *largest* monthly movements recorded at the Signal Service stations, viz: Pike's Peak, 18,496 miles; Cape May, 15,376; Sandy Hook, 13,982; Thatcher's Island, 13,704; Wood's Holl, 13,216; Cape Lookout, 13,136; Kittyhawk, 12,131; Barnegat, 10,860; Sandusky, 9,834; Milwaukee, 9,826; Indianola, 9,733; Eastport, 9,521. The *smallest* are: Visalia, Cal., 1,963 miles; Fredericksburg, Tex., 2,208; Uvalde, Tex., 2,589; Dubuque, Iowa, 2,600; Nashville, 2,763; Shreveport, 2,894; Lynchburg, 3,122; Virginia City, Mont., 3,165; Fort Davis, Tex., 3,330; Boise City, Idaho, 3,442; San Antonio, Tex., 3,471; Indianola, 3,570; Augusta, Ga., 3,594.

## VERIFICATIONS.

*Indications.*—The detailed comparison of the tri-daily weather Indications with the telegraphic reports for the succeeding twenty-four hours, show the general percentage of omissions to be 0.6 per cent., and of verifications to be 86.2 per cent. The percentage of verifications for the four elements have been: weather, 90.9; wind, 83.2; temperature, 86.2; barometer, 84.6. The percentage of verifications by geographical districts have been: New England, 85.5; Middle States, 86.0; South Atlantic States, 88.6; East Gulf

States, 87.0; West Gulf States, 83.5; Lower Lake Region, 87.0; Upper Lake Region, 88.1; Tennessee and the Ohio Valley, 86.3; Upper Mississippi Valley, 85.6; Lower Missouri Valley, 84.6. Of the 3,698 predictions that have been made, 122 or 3.3 per cent. are considered to have entirely failed; 177 or 4.8 per cent. were one-fourth verified; 356 or 9.6 per cent. were one-half verified; 303 or 8.2 per cent. were three-fourths verified; 2,741 or 74.1 per cent. were fully verified, so far as can be judged from the tri-daily weather maps.

**Cautionary Signals.**—167 Cautionary Signals were displayed, of which 140, or 83.8 per cent. were justified. 132 Cautionary Off-shore Signals were displayed, and of these 127 or 96.2 per cent. were justified as to direction; 118 or 89.4 per cent. were justified as to velocity. Of the Cautionary Off-shore Signals, 63 were changed from Cautionary. 299 signals of both kinds were displayed, of which 250 or 85.6 per cent. were fully justified. The above does not include signals ordered at 45 display stations where the velocity is only estimated and not measured. 110 cases were reported of winds of 25 miles or over where signals were not ordered; in only eight of these cases did the velocity reach 40 miles.

## NAVIGATION.

In the table, on right side of chart No. III, are given the highest and lowest readings, on the Signal Service river-gauges, during the month, with dates of same. On the 15th the *Tennessee*, at Chattanooga, was five feet above the danger-line, and on the 19th and 29th, respectively, the *Cumberland*, at Nashville, and the *Ohio*, at Pittsburg, rose within a few inches of the danger-line.

**Ice on Rivers and Lakes.**—*Missouri*—Leavenworth, 31st, river frozen over during entire month, ice about 20 inches thick, heavily loaded teams crossed daily. *Mississippi*—Minneapolis, Minn., 31st, ice in river 26 inches thick. La Crosse, 31st, river frozen over during month. Dubuque, 29th, ice in river weak and porous from recent high temperatures and travel across entirely ceased. Keokuk, 31st, wagons and foot passengers crossed the river on ice during nearly the entire month. St. Louis, 1st, river frozen solid above the bridge but clear in harbor to the south of it; 2d, river frozen, thin ice running in harbor; 3d, 4th, river frozen; 5th, river closed in harbor excepting a narrow channel one-fourth of a mile wide, south of bridge, ferries stopped running; 6th to 24th, river frozen; 25th, ice decaying; 26th, ferries and tug-boats broke up gorge in river, river clear from the bridge south to Carondelet; 27th, river remained the same south of the bridge, ferries and tug-boats breaking gorge north of bridge, ice quite rotten; 28th, gorge north of bridge partially broken up, very little ice running in river, heavy ice loosened from above in the evening; 29th, slush ice running in river, but clear north of bridge; 30th very little slush ice in river; 31st, heavy floating ice in river, steamer arrived in the afternoon from Cairo, navigation resumed. Cairo, river remained frozen to the 26th, breaking up in the evening; 30th, entirely clear of ice; navigation closed from December 28th, 1878, to January 30th, 1879. Memphis, 1st to 4th, 10th, 12th to 16th, floating ice in river; 14th, 16th to 27th, drift wood in river. Pt. Pleasant, La., 6th to 15th, floating ice in river. *Verdigris River*—Independence, Ia., 27th, ice broke up; 28th, river very high. *Arkansas*—Fort Gibson, 2d, river frozen over; 23d, ice all passed out of river; 27th, river rising rapidly and filled with floating ice and drift-wood. *Ohio*—Pittsburg, 3d, river frozen over; 24th, ice-gorge in river; 27th, ice-gorge broken up, navigation open. Wellburg, W. Va., 2d, river frozen over; 19th, ice started at 6:50 p. m., moved down about 100 feet and stopped, started again at 7:50 p. m., and run until about 11 p. m. 20th, ice started about 8 a. m. Cincinnati, 1st, floating ice in river, two boats left for Pomeroy, no arrivals; 2d, new ice covered the river, ice gorged for a short time, boats laid up, two arrivals, one from Kentucky river and one from Pomeroy; 3d, crossing river on ice five miles above station, ice gorged at many places between Aurora and Maysville; river closed in front of city at night; 4th, skating on river, ice gorged above and below city; 6th, skating and crossing on ice; 10th, ice in river still intact, rapid rise in the Kanawha, Guyan and Big Sandy rivers, and destruction of considerable floating property; many tug-boats employed in breaking up the ice in river near city; 11th, tug-boats breaking up the ice, pedestrians crossing on the ice; 12th, people crossing on ice, up to a late hour ice remained intact; 13th, river rising rapidly, ice broke at 4 p. m., ice running heavily and several gorges forming, very little damage done; 14th, heavy ice passing all day; 15th, heavy ice running until noon, navigation resumed; 16th, river rising, heavy ice passing; 17th, river falling, heavy ice passing; 18th, river rising, heavy shore-ice passing all day, ice in the Licking river began running out; 19th, river rising, very little ice passing, boats arriving report navigation very difficult and damaging the wheels, Licking river still running out, ice well broken up; 20th, river rising, heavy ice passing in the channel, in some instances twenty feet thick; 21st, river rising, very little ice passed, but in very large "bergs"; 22d, river falling, very large "bergs" running in morning, but very little ice in afternoon; 24th, river rising, very heavy ice passed on Ohio side in morning, navigation resumed from Parkersburg to New Orleans; 25th, river rising, floating ice in river; 26th, river rising, heavy ice passing in morning but disappearing in afternoon; 27th, river rising, scarcely any ice visible; 28th, river rising heavy ice passing all day; 29th, heavy ice passing all day thinning out some in the evening; 31st, river rising, no ice passed to-day. Cairo, 1st to 14th, heavy floating ice in river extending from shore to shore; 15th, 18th, about clear of ice; 13th, ice gorged in river above Paducah; 18th, Paducah, ice-gorge broke this morning; 20th, 21st, drift-wood in river; 22d, ten wrecks (barges and flat-boats) passed station during the day, caused by heavy floating ice; 19th to 22d, heavy floating ice in river; 23d to 25th, ice extending from Illinois shore to middle of river only; 26th to 31st, entirely clear of ice; navigation closed from December 25th, 1878, to January 26th, 1879; damage caused to shipping by heavy floating ice estimated at \$65,000. Louisville, 2nd, freezing along shore; 3d, river frozen over above station; 6th, river frozen over except in current; 14th, ice in river breaking up; 15th, ice-gorge passed station, carrying away several canal barges and driving a steamboat ashore; 22d, small quantities of floating ice in river;

2nd to 19th, Portland and Louisville canal frozen over; 20th, canal open; 22d, navigation resumed to-day. *Alleghany*—Tarentum, Pa., ice broke up; Pittsburgh, 3d, river frozen over; 18th, river open for several miles above city; 19th, ice gorge broke about noon, sinking a number of canal boats and barges; 20th, 21st, 22d, river full of floating ice; 24th, little ice in river; 25th, river clear of ice; 28th, ice running all day; 29th river full of floating ice; 30th, heavy ice moving all day; 31st, ice nearly all out. *Monongahela*—Morgantown, 17th, ice gorged in river, carrying away portion of river gauge, water rose twelve feet in 30 minutes; 21st, heavy ice in river; 22d, river clear of ice; 23d, floating ice in river. Pittsburgh, 3d, river frozen over. *Buffalo Creek*—Wellsburg, West Va., 18th, ice run out, thawing rapidly. *Scioto River*—Columbus, 28th, ice broke up. *Tennessee River*—Chattanooga, 9th, two steamers sunk between Kingston and London by floating ice; 10th, river rising rapidly, gorge giving way above; 13th, river reached danger line; 14th, river rising rapidly and overflowing lower portions of city; 15th, river reached highest point, 38 feet above zero of gauge; 16th, river falling. *Roanoke River*—Weldon, N. C., 3d, 4th, full of floating ice; 5th, frozen over solid, which had not occurred before since 1857; 6th, river seems to have stopped flowing, no water in view, ice seems to be lying on the bed of the river; 7th, one or two small streams commenced to flow on top of the ice; 8th, ice broke up and began moving in immense quantities; 12th, river high and rising, channel clear, ice heaped near the shore; 13th, river overflowing banks and rising all day; 14th, still rising, about three inches during the day and twelve during the night; 15th, rose five inches during day. *Red Is and Creek*—Wytheville, Va., 12th, ice gorged, water overflowed the low ground, carrying away six cattle; in a short time gorge burst and tore out part of mill dam, carried off considerable material and excavated huge rocks, damage estimated at \$500; 11th, ice moved out of Barrett's dam during the night; 12th, water very high. *Rivanna River*—Broad Oak, Va., 22d, river clear of ice. *James River*—Dover Mines, Va., 14th, river clear of ice; 16th, canal open to navigation, having been closed by ice for twenty-one days. *Potomac River*—Ft. Whipple, Va., 1st, ice in river firm; 2d, river still frozen; off Ft. Foote, 3d, ice 12 in. thick. Georgetown, continued frozen during the month. *Patapsco*—Woodstock, Md., 9th, river open. Baltimore, 3d, harbor and basin covered with solid ice, navigation almost entirely suspended; 4th, several tug boats fast in the ice near Annapolis; schooner "Eastern Light" sunk off Hell Point, with 300 bushels of oysters, and schooner "Burning Hall" sunk near Highlands, the crews of both being compelled to make their escape on the floating ice; several oyster schooners fast in the ice and abandoned by the crews; 5th, fourteen tug boats and several oyster schooners ashore down the river. *Susquehanna*—Catawissa, Pa., north branch closed during month. *Hudson*—West Point, N. Y., 3rd, river completely frozen over; New York, 3rd, floating ice in river, causing many interruptions to travel; Sandy Hook, 3rd, bay full of floating ice. *Flushing Bay*—Flushing, N. Y., 31st, navigation still closed. *Narraganset Bay*—Newport, 3rd, ice forming in harbor. *Buzzards Bay*—New Bedford, Mass., 6th, harbor covered with ice; 28th, ice breaking up. *Vineyard Sound*—Wood's Holl, 3rd to 12th, ice in harbor; 13th, 25th, ice gorge in harbor. *Otta Queche River*—Woodstock, Vt., ice on river 19 inches thick. *Lake Superior*—Duluth, 14th, ice forming rapidly on surface of lake; 15th, lake frozen; 26th, ice breaking up, harbor full of floating ice. *Lake Geneva*—Bloomfield, Wis., 6th, ice sixteen inches thick. *Lake Michigan*—Grand Haven, 7th, miles of ice on lake outside of pier; 15th, in many places at the distance of half a mile from shore ice 30 to 35 feet deep, extending to the bottom of the lake; 16th, outlet made for the ice-bound vessels, through the force of the high east winds starting the ice. *Embarrass River*—Embarrass, Wis., 29th, ice on river 24 inches thick. *Grand River*—Grand Haven, 7th, river frozen over to a considerable distance from its mouth, ice extends nearly to the bottom; 15th, workmen trying to cut a channel at the mouth of river to liberate the ice-bound vessels. *Grand Traverse Bay*—Northport, Mich., 31st, no ice in bay. *Lake Erie*—Sandusky, 6th, teams came over ice from North Bass Island, distance twenty-four miles; ice in middle of lake reported 14 inches thick. Cleveland, 3rd, lake covered with ice as far as the eye could reach, 6th, lake still frozen; 7th, ice in lake broken; 21st, heavy ice on lake; 27th, ice solid; 29th, ice breaking up; 30th, ice driven ashore. *Cuyahoga River*—Cleveland, 21st, ice in river, 33 inches thick; 27th, ice breaking up. *Lake Champlain*—West Charlotte, Vt., 30th, lake mostly frozen over; 31st, floating ice in lake. Burlington, 10th, navigation closed; 29th, lake entirely frozen over; the records at this place show that the average date of closing, for the last sixty years, has been on January 29th.

*Low Tides*.—Indianola, Tex., 1st to 21st; Tybee Island, Ga., 12th; Baltimore, 4th and 5th, lowest tide on record.

## TEMPERATURE OF WATER.

The temperatures of water, as observed in rivers and harbors, with average depth when observations were taken, are given in table on chart No. II. At Alpena, Buffalo, Cleveland, Escanaba, Grand Haven and Sandusky no observations were made on account of ice. At the following stations observations were only made on the dates named: at Burlington, from the 1st to 12th; Chicago, 24th to 31st; Detroit, 29th to 31st; Duluth, 1st to 14th and 27th to 31st; and at Marquette, 26th to 31st. Punta Rassa, Fla., (too late for table on chart,) max. 70°, min. 54°, average depth, 12 feet.

## ATMOSPHERIC ELECTRICITY.

*Thunder-storms*.—Louisville, Ill., 28th; St. Meinrad, Ind., 28th; Bowling Green, Ky., 28th; Lebanon, Mo., 28th, Tarentum, Pa., 27th; McMinnville, Tenn., 28th; Thomasville, Ga., 12th; Pt. Pleasant, La., 11th, 27th; Okalooska, La., 7th; Franklin, N. C., 28th; Clarkesville, Tex., 27th; San Antonio, Corsicana and Castroville, Tex., 26th; Shreveport, La., 11th; St. Louis, 28th.

*Telegraphic Communication interfered with by Atmospheric Electricity:* Bismarck, Dak., 7th, line heavily charged.

*Auroras.*—Wood's Holl, Mass., 13th; Thomasville, Ga., 17th; Cambridge, Mass., "aurora regularly looked for every day at 8 p. m.; moonlight at 8 p. m. on the 5th, 6th, 10th, 29th to 31st, some clouds in the north on the 6th to 14th, obscured on the 1st, 2nd, 3rd, 4th, 7th, 8th, 9th, 11th, 15th, 17th, 21st, 22nd, 24th, 27th and 28th, clear but no aurora on 12th, 13th, 16th, 18th, 19th, 20th, 23rd and 25th;" Franklin, N. C., 23rd; Pembina, Dak., 23rd; Ft. Davis, Texas, 19th; Madison, Wis., 28th; Eastport, 1st, 21st and 24th; Boston, 24th.

## OPTICAL PHENOMENA.

*Solar Halos.*—1st, Ia., Mass., Vt., Mich., N. Y., Cal., Dak., Minn., Kan. 2nd, Ia., Mich., Dak., Neb., Minn., Kan., Ill., Ind., Me. 3rd, Ia., Ohio, Conn., Ill., Col., Cal., Dak., Minn., Wis., Ga. 4th., Ia., N. J., Tenn., N. C., Neb., Dak., Wis. 5th, Dak., Minn. 6th, Ind., Kan., Vt., Wis., Me., Dak., Kan. 7th, Me., N. C., Ill., Neb., N. Y., Pa., Vt., Dak., Ohio. 8th., Ia., Kan., Neb., Dak., Minn. 9th, Ia., Kan., Dak., Minn. 10th, Ia., Mich., Mo., Cal., Kan., Minn. 11th, Ia., Mass., N. J., Vt., Va., N. Y., Conn. 12th, Ia., Me., Mass., N. Y., Conn., Dak. 13th, Ia., Mass., Neb., Vt., Dak. 14th, Ia., Ill. 15th, Pa. 16th, Kan., Mich., Dak., Tenn. 17th, Ia., Me., Mass., Mich., N. Y., Vt., Conn., Ill., Pa. 18th, Ia., Dak., Neb., Minn. 19th, Vt., Dak. 20th, Me., Ohio., Ill., Wis. 21st, Ia., Me., Mass., N. Y., Ohio, Vt., Fla., Conn., Ill., Utah., Dak. 22nd, Ind., Ohio., Conn., Ill., Mo., Ia., 23rd, Ill., Wis. 24th, Mass., Ohio, N. Y. 25th, Ia., Ohio., Tex. 26th, Ia., N. Y., Utah. 27th, N. C., Mich., Ga. 28th, Ia., N. Y., Ohio, Ga. 29th, Ohio., Vt., N. J., Mich., Neb. Col., Ia., N. Y., Ga. 30th, Ia., Ill., Neb., Ohio. 31st, Ind., Ia.

*Lunar Halos.*—1st, Ia., Me., N. Y., Dak., Ill., Ind., Mass., Mo., Vt., Tex., Ala. Wis., Minn., Ga. 2d, Ia., Ohio, Ill., Conn., Ind., Mich., Tex., Minn. 3d, Kan., N. J., Wis., Ill., N. Y., Conn., Cal., Me., Vt., Nev., Ind. Ty., N. C., Mass. 4th, Mass., N. J., N. C., Ill., N. Y., Conn., Mo., Wis., Minn., Ohio, Tenn., Me., R. I. 5th, Md., N. J., Ill., Tenn., Conn., Me., Mont., Dak., Tex., Minn., Ind. 6th, Ind., Me., Mass., Ohio, Va., Tex., Ill., Ia., Mo., Ind. Ty., La., Wis., Mich., N. Y. 7th, Ia., Me., Md., Mass., N. J., Pa., Va., Neb., Mich., Tenn., N. Y., Conn., Ga., Col., Dak., Minn., Wis., W. Va. 8th, Ohio, Cal., Ill., Nev., Dak., Minn., Wis., Ia., Pa. 9th, Ia., N. Y., Ohio, Neb., Ind., Ind. Ty., Minn. 10th, Ill., Mass., Ohio, Va., Tex., Mich., Tenn., N. C., Conn., W. Va., Dak., Ia., Ga., Md., Ind. 11th, N. Y., Pa., Va., N. C., Mo., Tex., Wis., Ohio. 12th, Conn., Idaho, Tex., Ga., Me. 13th, Nev., Ia., Ga. 14th, Ind., N. Y., Me., Mo. 16th, Neb., 17th, Ind., N. Y. 18th, Ill. 21st, Ill. 24th, Ohio, Ill., Ia. 25th, Ill., Va. 26th, Ia., Mich., Mo., Ala., Tenn. 27th, Tex., Mo., Neb. 28th, N. J., N. Y., Va., Wis., Mo., Neb., Tex., N. M., Ga. 29th, Ind., Kan., Ohio, Va., Mich., Mo., Col., Tex., W. Va., Ga. 30th, Ill., Ind., Neb., Ohio, Ia., Cal., Minn., Wis., Mich., Ga. 31st, Ind., Me., N. J., Ohio, Ia., Mo., Dak., Minn., Tex., La. Me., Vt.

*Mirage.*—Genoa, Neb., 1st, 3rd; Olivet, Dak., 26th, 29th, 30th; New Bedford, Mass., 15th; Pembina, Dak., 28th; Burlington, Vt., 3rd, 5th.

## MISCELLANEOUS PHENOMENA.

**BOTANICAL.**—*California*—Sacramento, 23rd, poplar and other trees in bud. *Florida*—Mayport, 5th, oranges were picked encased in half an inch of ice; fruit uninjured. Houston, 8th, coldest morning for years; young orange trees are injured, but the bearing trees are not hurt; 31st, oats nearly all sown and corn planting commenced. *Georgia*—Forsyth, 29th, alder bushes in full bloom, plum trees beginning to bloom. Augusta, 25th, elm trees budding; 27th, trimming trees about the city, planting English peas and early garden vegetable seeds; 29th, japonicas in full bloom in the open air; 30th, peach trees beginning to bloom. *Indiana*—Green Castle, 23rd, buds of the peach, plum and cherry are generally killed, and the peach trees are largely, if not generally, killed; wheat is in the best condition, having been well protected by the snow. Brookville, 23rd, wheat crop greatly benefitted by the heavy covering of snow; peaches killed, apples not injured. Greensburg, 23rd, wheat crop in fine condition, much benefitted by the snow. Madison, 23rd, peaches all killed, cherries and grapes have suffered much; wheat well preserved and protected. Anderson, 23rd, wheat in splendid condition; fruit generally believed uninjured. Vincennes, 23rd, fruit only slightly damaged; prospect for wheat very promising. Indianapolis, 23rd, wheat in splendid condition, abundant harvest anticipated; peaches all killed and trees somewhat damaged; apples not injured; pears—fruit all killed, trees uninjured; cherries—fruit all killed, trees uninjured; grapes—some tender varieties killed; raspberries all damaged; quinces—fruit all killed and trees badly damaged; blackberries killed to some extent; strawberries in fine condition, being protected by the snow; grass in excellent condition. Shelbyville, 23rd, fruit crop considerably injured, peaches believed destroyed; wheat much benefitted by the snow. Aurora, 22nd, wheat crop good; fruit crop much injured, especially peaches and cherries. Ft. Wayne, 23rd, fruit not as much injured as anticipated; wheat has received no damage. Vevay, 31st, peach trees, most flowering shrubs and hardy hybrid roses are killed; great quantities of potatoes frozen in pits; wheat never looked more promising and thrifty; herbaceous plants have been saved by the covering of snow. *Illinois*—Mt. Carmel, 23rd, grain crop greatly benefitted by the heavy snow, peaches entirely destroyed in some localities; apples not believed to be injured. *Iowa*—Independence, 27th, sap rising in osage orange, horse radish and parsnips sprouting. *Kansas*—Holton, 31st, peach buds in some localities reported killed. *Kentucky*—Nicholasville, 22nd, wheat and grass are uninjured, the average of the former is very large; fruit growers state that there will be no fruit of any kind worth mentioning; young trees of all kinds are dead and many large trees froze and burst; flowers in pits suffered severely. Greenup, 24th, fruit crop

severely injured except in sheltered localities; wheat crop decidedly improved by the heavy snow. Maysville, 23rd, in some localities peaches and cherries have been killed by the cold, but generally these fruits have been saved; all other fruits give indications of abundant yields; wheat looks green and fresh and its growth vigorous. Ashland, 23rd, amount of wheat sown is small compared to last year, but it is in a flourishing condition. Harrodsburg, 24th, fruit buds not injured much; wheat well protected. Paris, 23rd, it is generally believed that all crops are not much injured by the snow or cold; in some portions of the Blue Grass region the fruits will all be lost. Adair Co., 14th, the prospect for a good wheat crop very promising. Woodford Co., 13th, wheat crop looking very fine, well protected by the snow. Grayson Co., 15th, wheat crop very promising up to December 15th, when by hard wet freezes its leaves were turned to a rusty brown color; it is now well protected by the snow and an average crop is anticipated. Bowen Co., 15th, the prospects are favorable for a good wheat crop; a full crop was sown. Todd Co., 16th, wheat looking very well; it is deeply covered with snow; a good crop is expected. Breckenridge Co., 16th, a very small acreage of wheat was sown here last fall, but it is looking well, and a rich harvest expected.

*Louisiana*—Okalooska, 31st, grass starting, leaf buds on rose bushes opening. *Maryland*—Sandy Springs, 3rd, hundreds of bushels of potatoes froze in cellars. *Mississippi*—Brookhaven, in bloom, 22nd, hyacinth, 29th, jonquils; leafing, 23rd, woodbine, 29th, spirea, 30th, flowering almond and blackberry; 23rd, strawberries ripe, but tasteless; Fayette, in bloom, 25th, daffodils, 30th, spirea. *Missouri*—Oregon, 26th, vegetables, grains, grasses and weeds, uncovered by the melting snow, were found to have been growing all winter. Springfield, 31st, buds of peach and raspberry reported killed; 29th, blue grass sprouting and quite green. Louisiana, 31st, buds of peach and apricot killed. Lexington, 31st, peach buds safe along the river, but reported entirely killed six miles from the river. *Nebraska*—Genoa, 30th, frost out of ground, farmers seeding spring grain. Omaha, 31st, grass growing through the grain stubble, willow and cottonwood trees budding. *North Carolina*—Fayetteville, budding, 15th, japonicas; 21st, swamp bilberry and spirea; 21st, hyacinth and crocus sprouting; 21st, violets in bloom throughout month in the open air. *Ohio*—Tiffin, 22nd, wheat crop considered safe, but peach trees, without doubt, killed entirely by the severe cold. Lancaster, 22nd, many acres of corn still in the shock; wheat in good condition, saved by heavy snow; peaches and other small fruits very severely injured, but with apples and pears it is more favorable; all but the hardiest species of grapes have been extensively injured. Mansfield, 22nd, wheat greatly benefitted by the heavy snow; peaches generally conceded to be killed. Urbana, 22nd, wheat doing nicely; apples in fine condition, but not so well with peaches. Marysville, 22nd, so far the winter remarkably favorable to the wheat crop; so far as can be ascertained, peaches and the earlier varieties of cherries are badly injured. Franklin, 22nd, wheat considered generally safe; peaches almost entirely destroyed; apples and pears still in pretty good condition. Germantown, 22nd, fruit raisers are uniform in the opinion that the present prospects are good for an average crop. Adams Co., 22nd, wheat and grass well set and protected nicely by the heavy snow, prospects of a good crop; grapes and peaches very unfavorable; cherries, currants and plums not injured; apples in good condition; some fears expressed as to the pear crop. Kenton, Hardin Co., 22nd, wheat crop saved by the heavy snow; apples, peaches, pears and cherries have all been killed. Hamilton, 22nd, prospects flattering for large crops of wheat and barley. Cuyahoga Co., 22nd, much fear is expressed regarding the grain and grass crops, as the high winds have blown the fields bare in many places, exposing to the severe cold the tender roots of the plants; buds of the peach, pear and cherry are not far enough advanced yet to be subject to much injury. Cadiz, 22nd, wheat crop well protected by the snow; it is claimed by some that the peaches are all killed. Oxford, 24th, fruit is in all probability greatly injured. New Philadelphia, 23rd, it is the general opinion that the wheat crop is not injured, except, perhaps, in a few localities, on low, wet ground, where ice had formed. Columbus, 24th, weather very favorable to the wheat crop, it is well protected by the snow; peach buds are destroyed, and probably cherries and other small fruits; apples are uninjured. Middletown, 24th, wheat and barley well protected by the snow, and doing nicely; apples are not hurt, but it is believed that peaches are all killed, and many trees frozen to death; grapes and other small fruits are hurt some, but not all destroyed. Gallipolis, 22nd, wheat preserved from injury by the heavy snow; in some cases peaches reported killed and trees split open by the intense cold. Chillicothe, 23rd, wheat comparatively uninjured, the snow protecting the roots; peaches are almost entirely destroyed. Greenfield, 23rd, wheat crop very promising; barley safe. Licking Co., 23rd, wheat and grass healthy and fresh, prospects of an abundant harvest; farmers and fruit growers express the opinion that the extremely low temperature has not only injured the fruit buds, but also the trees, especially the peach. Coshocton Co., 23rd, wheat crop in good condition; it is the general opinion that fruit is not injured, except peaches, in some localities. Eaton, 24th, grapes and peaches are conceded to be almost entirely destroyed; wheat in a fine, green condition. Dayton, 24th, grain well protected by snow; peaches in some localities severely damaged; apples and plums somewhat affected. Jackson, 23rd, fruit comparatively safe; wheat well protected. Fremont, 23rd, wheat in splendid condition; peach and cherry buds killed; peach trees not much injured, but apple trees in some instances have burst. Circleville, 22nd, the more tender varieties of fruit—peaches, cherries, &c.—are killed; many house plants frozen. Canton, 23rd, peach trees are very generally killed by the frost, while apple trees have escaped untouched; wheat and grass are in good condition. Barnesville, 23rd, peach crop is considered destroyed, many of the trees have actually burst from the frost; wheat is looking fine, and a large crop is expected. *Texas*—Melissa, 31st, very little farm work done during the month on account of cold, wet weather; farmers are now beginning to plow vigorously. *West Virginia*—Parkersburg, 22nd, wheat crop uninjured; fruit crop considerably injured; peaches ruined and many trees killed. Wheeling, 23rd, wheat reported in excellent condition, and the largest crop ever known is predicted; fruit very little injured, except peaches; a very heavy crop of apples is anticipated. *Wisconsin*—Embarras, 31st, winter grain suffering from severe cold.

**BIRDS.**—*Geese*.—St. Meinrad, Ind., 16th, flying N.; Somerset, Mass., 1st, S.; Corning, Mo., 3rd, Plattsmouth, Neb., 24th, SE.; Norfolk, Ohio, 2nd, SW.; Dover Mines, Va., 7th, S.; Independence, Ia., 22nd, 24th and 25th, N.; Emory Grove, Md., 28th, SE.; Oregon, Mo., 27th; Melissa, Tex., 28th and 30th; Sacramento, Cal., 26th; Ft. Sill, Ind. Ty., 30th; Ft. Gibson, Ind., Ty., 28th. *Crows*.—Monticello, Ia., 28th; Bethel, Ohio, 27th; Northport, Mich., 31st; Oregon, Mo., 30th; Ringgold, Ohio, 22nd, 23rd and 25th. *Chickadees*.—Rowe, Mass., 19th; Northport, Mich., 31st. *Robins*.—Elmira, Ill., 27th; Creswell, Kan., 27th and 29th; Fall River, Mass., 12th; Bethel, Ohio, 27th; Dover Mines, Va., 9th, immense flocks appeared; Broad Oak, Va., 2nd and 31st, large flocks; Wellsburg, West Va., 2nd; Nora Springs, Ia., 20th; Glasgow, Mo., 25th; Ringgold, Ohio, 25th and 29th; Ft. Gibson, Ind. Ty., 2nd, large flocks flying S. *Rice Birds*.—Uvalde, Tex., 17th. *Blue Birds*.—Plattsmouth, Neb., 24th; Weldon, N. C., 22nd; Bethel, Ohio, 28th; Broad Oak, Va., 31st, large flocks; Nora Springs, Ia., 30th; Glasgow, Mo., 28th; Ringgold, Ohio, 29th. *Sparrows*.—Monticello, Ia., 16th and 22nd. *Red Birds*.—Bethel, Ohio, 27th; Oregon, Mo., 20th to 22nd, 24th; Springfield, Mo., 24th. *Bluejays*.—Monticello, Ia., 15th, 21st; Rowe, Mass., 19th, 26th; Oregon, Mo., 18th; Springfield, Mo., 24th. *Winter Wrens*.—Fallston, Md., 25th. *Owls*.—Oregon, Mo., 6th, 27th. *Snow Birds*.—Monticello, Ia., 5th; Rowe, Mass., 6th, 14th, 20th; Emory Grove, Md., 8th, 24th; Oregon, Mo., 7th, 11th, 17th. *Eagles*.—Northport, Mich., 31st. *Waxwings*.—Rowe, Mass., 4th, 8th, 10th, 11th, 19th, 20th, 22nd, 24th, 25th, 30th. *Mocking birds*.—Weldon, N. C., 24th. *Ducks*.—Creswell, Kan., 7th, 13th, 20th, 22nd, 25th; Lebanon, Mo., 29th; Northport, Mich., 31st; Ft. Gibson, Ind., Ty., 8th.

**MISCELLANEOUS.**—*Frogs piping*.—Fort Barrancas, Fla., 23rd; Okalooska, La., 17th; Fayetteville, N. C., 24th; Fayette, Miss., 14th. *Bats*.—Uvalde, Tex., 28th. *Moths*.—Fayetteville, N. C., 24th to 28th. *Wasps*.—Fayette, Miss., 17th, 25th. *Black Beetles*.—Fayetteville, N. C., 24 to 28th. *Lady Bugs*.—Independence, Iowa, 27th. *Lizards*.—Fayette, Miss., 29th. *Mosquitos*.—Okalooska, La., 29th. *Bees*.—Fayette, Miss., 28th, carrying pollen.

*Meteors*.—Anna, Ill., 18th, 27th; New Corydon, Ind., 16th, 22nd, 30th, 31st; Ft. Dodge, Ia., 7th, 22nd; Fallston, Md., 16th, 7:45 p. m., large meteor moving W. along the S. horizon, color of red-hot iron, motion horizontal, altitude 30°; Woodstock, Md., 1st, 14th, 18th, 21st, 22nd; Sandy Springs, Md., 11th; Rowe, Mass., 12th, 14th, 29th; Atco, N. J., 11th; Wappinger's Falls, N. Y., 10th, 20th, 22nd, 25th; Atlantic City, N. J., 20th, 10 p. m., very brilliant meteor, descended from a point 10° S. of zenith, no fragment or train of light were seen to follow in its course. Detroit, Mich., 25th; Ft. Pembina, Dak., 15th; Southington, Conn., 22nd; Iowa City, Ia., 29th; Thoinville, Mich., 10th, Oregon, Mo., 12th, 17th, 18th, 21st; North Volney, N. Y., 24th; South Hartford, N. Y., 23rd; Jacksonburg, Ohio, 25th, 26th, 29th; Boise City, Idaho, 18th; Ft. Davies, Tex., 11th; Savannah, Ga., 14th, 29th; Charleston, 29th.

*Zodiacal Light*.—New Corydon, Ind., 3rd, 5th, 16th, 18th, 23rd, 24th, 28th, to 31st; Cresco, Ia., 12th, 16th, 17th, 19th, 23rd; Monticello, Ia., 9th, 12th, 17th, 18th, evenings; Topeka, Kan., 11th; Orono, Me., 10th, 14th, 23rd, evenings; Somerset, Mass., 10th, 13th, 14th, 18th, 20th, 22nd, 23d, 24th, evenings; Corning, Mo., 18th; Atco, N. J., 10th, 13th, 14th, 18th to 23rd, evenings; Princeton, N. J., 16th, 23rd; Waterbury, N. Y., 12th, 13th, 18th, 23rd; Bellefontaine, Ohio, 16th, 19th, 20th, 21st, 23rd, 25th; Wytheville, Va., 11th, 13th, 19th, 21st, 22nd, 23rd, 25th; Rowe, Mass., 12th; Southampton, Conn., 18th, 22nd, 23rd; Olivet, Tak., 15th to 31st; Iowa City, Ia., 12th; Okalooska, La., 19th and 20th; Cambridge, Mass., regularly looked for at 8 p. m., and distinctly seen on the 12th, 13th, 18th, 20th, 23rd, visible through haze or among clouds at about 6:30 p. m., on the 14th, 16th, 19th, visible or suspected in moonlight on the 10th, 25th, observations on other evenings hindered by strong moonlight or clouds; Oregon, Mo., 11th to 13th, 16th to 25th; New Ulm, Tex., 23rd; Savannah, Ga., 10th, 13th, 14th, 19th, 20th, 21st, 24th, evenings; Newbury, Vt., 10th, 14th, 15th, 16th, 23rd, evening. Looked for regularly before sunrise and after sunset at Mount Washington, but none observed, and at Pike's Peak but observed only on 26th, evening.

*Polar Bands*.—New Corydon, Ind., 5th, 6th, 10th, 18th, 20th, 24th, 25th, 28th, 30th. West Waterville, Me., 1st, 2nd, 4th. Wytheville, Va., 3rd, 7th, 11th, 13th, 15th, 17th, 20th, 26th, 30th. Nirvana, Mich., 24th. Woodstock, Vt., 7th, 17th, 19th.

*Prairie Fires*.—North Platte, Neb., 24th to 26th; Independence, Ia., 29th; Fort Sill, Ind. Ty., 22d; Eagle Pass, Tex., 15th, 16th; Brackettsville, Tex., 17th, 19th; New Orleans, La., 3d, 17th, 26th.

*Earthquakes*.—November, U. S. Naval Hospital, Yokahama, Japan, 22nd, 11:12 p. m., heavy shock lasting one minute; 11:21 p. m., light shock; 26th, light shock lasting twenty seconds. December 17th, at Yuma, Arizona, 4 p. m., slight shock, lasting eight seconds, perceptibly shaking buildings; and at Campo, Cal., 4:03 p. m., two very slight shocks, lasting about two seconds, motion from the SW., accompanied by a low rumbling noise. January, Arequipa, Peru, 9th, 11:15 p. m., a most severe shock. Iquique, Peru, 12th, about midnight long and violent shock accompanied by curious subterranean noise. On the 12th, in Fla., at Jacksonville, 11:40 p. m., two distinct shocks, lasting about 30 seconds; motion from NW. to SE.; some persons reported a slight rumbling noise accompanying the shocks; houses all over the city were felt to move; the telegraph operator at Lake City reports the shock as felt there almost simultaneous with Jacksonville; at Mayport observer states that all his household were awakened by the rattling of the doors and windows; a sort of undulatory motion of the house was only perceptible; at Gulf Hammock, 11:55 p. m., slight shock, a sudden impulse followed by a few vibrations; at Daytona, 11:50 p. m., "a violent shaking and a loud rumbling noise as if an approaching train of cars, then as if they jumped the rails and ran over the sleepers for a few seconds; clocks stopped and people were awakened and terribly frightened; direction probably from east to west; duration, four to six seconds. At Okahumpka, Fla., 12 p. m., observer states that he felt a shock, direction NNW. to SSE., lasting at least one minute, accompanied by a peculiar buzzing sound; vibrations of sufficient force to slightly rock his house, rattling glasses, dishes, &c., on the shelves. St. Francis Barracks,

St. Augustine, Fla., 13th, 11:55 p. m., two almost imperceptible tremblings were experienced, lasting about two seconds, with the same intervals of rest; these were followed by a rapid vibratory motion, apparently from east to west, lasting two or three seconds; in the small and weaker houses of the town small objects were thrown from shelves by the shock; plaster was detached from the walls of houses in several places; the sentry on post reports hearing at the time a heavy explosion as of a distant torpedo at sea.

**Sunsets.**—The characteristics of the sky at sunset, as indications of fair or foul weather for the succeeding twenty-four hours, have been observed at all Signal Corps Stations. Reports from 117 stations show 3,597 observations to have been made, of which 39 were reported doubtful; of the remainder 2,921, or 81.2 per cent. were followed by the expected weather.

**Sun Spots.**—The following monthly record of observations by Mr. D. P. Todd, Nautical Almanac office, Washington, D. C., is communicated by Prof. S. Newcomb, U. S. Navy, in charge of that office:

JANUARY 1879.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Remarks.
	Groups	Spots.	Groups	Spots.	Groups	Spots.	Groups	Spots.	
2nd, 2 p. m...	1	2	0	0	0	0	1	2	Small group of faculae.
" 3 p. m...	0	0	0	0	0	0	1	2	
4th, 3 p. m...	0	0	1	2	0	0	0	0	
7th, 2 p. m...	0	0	0	0	0	0	0	0	
13th, 3 p. m...	0	0	0	0	0	0	0	0	
14th, 3 p. m...	0	0	0	0	0	0	0	0	
16th, 2 p. m...	0	0	0	0	0	0	0	0	
18th, 2 p. m...	0	0	0	0	0	0	0	0	
20th, 2 p. m...	0	0	0	0	0	0	0	0	
21th, 3 p. m...	0	0	0	0	0	0	0	0	
23rd, 4 p. m...	0	0	0	0	0	0	0	0	
25th, 2 p. m...	0	0	0	0	0	0	0	0	
27th, 2 p. m...	0	0	0	0	0	0	0	0	
29th, 3 p. m...	0	0	0	0	0	0	0	0	

Mr. Jay Harcourt, at Wappinger's Falls, N. Y., examined the sun on the following days, but observed no spots: 6th, 7th, 12th, 14th, 18th to 20th, 22nd, 25th, 26th, 29th, 30th, 31st. Mr. David Trowbridge, at Waterburg, N. Y., examined the sun on the following days, but observed no spots: 1st, 11th to 13th, 17th, 22nd, 24th to 26th, 28th to 31st. Mr. William Dawson, at Spiceland, Ind., examined the sun on the following days, but observed no spots: 18th, 21st, 26th, 28th, on the 30th one group was seen with two spots. Prof. G. Hinrichs at Iowa City, Ia., examined the sun on twenty days, no spots seen. Observations were also continued daily at Fort Whipple, Va., but no spots observed.

## NOTES AND EXTRACTS.

**Atmospheric Electricity.**—In *Nature* for January 2d is given a report on the observations of atmospheric electricity made seven times a day at Montsouris. It is stated that during a recent long continuance of high pressure, and with a variety of cold and unpleasant weathers, the indications were invariably of positive electricity; that the change to negative electricity took place simultaneously with the change to warmer, thawing weather. At page 220, January 9th, it states that the electric indications at Kew were the same as at Montsouris.

**Clouds and Weather.**—The following extracts are from a lecture by W. C. Ley, on clouds and weather-signs, (*Nature*, 1878, page 178):

"As regards configuration, clouds seem naturally divisible into two groups, those which arrange themselves in layers, whose vertical diameter is small as compared with its horizontal, and those which assume spherical or hemispherical shapes; and this division is related to certain physical conditions of the atmosphere and of the earth's surface beneath the cloud. It is, however, essential that we should possess some name or system of names to distinguish those clouds which are conveyed by the upper currents, and the term cirrus, with its compounds, must be more closely restricted to this class of clouds than has yet been done. From the use of weather-maps a new science of the winds has originated, on which all attempts at weather forecasting must be based. The movements of the upper clouds afford most valuable information concerning the distribution and movement of the areas of high and low barometric pressure. Rules by which this information may be interpreted, based in great measure on a former investigation by the lecturer,<sup>1</sup> are somewhat complex, and cannot well be given in a brief *résumé* like the present.<sup>2</sup> It may be sufficient to explain that in the front of an advancing barometric depression there usually extends a bank of the halo-producing cirro-stratus, the exterior edge of which is, roughly speaking, a parabola, the focus of which lies in the line about to be traversed by the centre of the depression. On the right-hand of the centre this bank or sheet is abruptly broken and is succeeded in the rear by local shower-clouds. On the left-hand the sky commonly continues overcast, but the cloud-plane gradually descends until little is to be seen but low stratus. A backing of the upper current takes place until after the centre of the depression has passed. In whatever direction a depression is advancing the same characteristic phenomena are observed. Thus changes in the clouds indicate to us probable alterations of wind and weather."

"While the nimbus, which exists in the front of a depression, first makes its approach evident by changes in the higher cloud-strata, the process of nubification is the converse of this in those local showers which commonly occur on the right-hand and in the rear of a centre of depression, and therefore when the baro-

meter is rising or just about to rise. These latter are developed in an upward direction through the formation of cumulus. The precipitation which occurs in them—always preceded by a change of appearance in the domes of cloud, which assume a soft and cirriform aspect—is attributed to the neutralization of electricities as the summit of the cloud passes into a higher region; but there are important differences of appearance between those cumuli which are likely, and those which are unlikely, to undergo this transformation."

<sup>1</sup> "Relation between the Upper and Under Currents of the Atmosphere around Areas of Barometric Depression." *Quart. Journ. of Met. Soc.* vol. iii. p. 437. <sup>2</sup> The lectures will shortly be published.

**Scintillation of Stars.**—From observations for many years on the scintillation of the stars, Montigny derives the following conclusions, (*Nature*, page 233):

"M. Montigny tried to solve the question whether the changes of colour in scintillation follow certain definite laws; whether, for instance, their relative frequency expressed in numbers, shows differences which depend on the nature of the star's own light, on the star's elevation above the horizon, or on the condition of the atmosphere."

"The way in which the observations were made was the following:—For each evening of observation, not only the values for the intensity of scintillation were entered for each star, reduced to a distance of 60° from the zenith, but each single color observed in the circular image was also noted down. Further the observations made in wet weather were noted separately from those made during dry weather. Finally the various colors were entered on a table divided into seven columns, respectively headed—red, orange, yellow, green, blue-green, blue, and violet. The sum total of any column thus indicates the number of times which the color in question was observed in a certain star. Arcturus, for instance, in 131 observations during moist weather, showed the red color 130 times and blue 118 times. These numbers thus express the absolute frequency of these two colors. If we compare the number of 130 for red, with the sum total of all colors shown by Arcturus during rainy weather, which is 491, then we obtain the relative frequency of red, which is 0.265, or multiplied by 1000 = 265. Therefore in 1000 changes of color which appeared in Arcturus during rainy weather, red occurred 265 times, and blue 240 times."

"The observations show, (1) the relative frequency of red is far greater than that of any other color in rainy weather as well as in dry; (2) red, green, and particularly orange, are seen more frequently in dry weather than in wet; (3) the frequency of yellow and blue is on the contrary greater in wet weather than in dry."

"Although the differences in the frequency of one and the same color, according to the state of the atmosphere, are rather limited, they nevertheless indicate an important fact. It is also remarkable that the numeric differences in the complementary colors red and green on the one hand, and blue and yellow on the other, lie in the same direction. It is further worthy of notice that the greater frequency of blue in rainy weather agrees well with the fact that the blue greatly predominates during such weather in the image of the star as shown by the scintillometer. This predominance of blue has also been frequently observed a short time previous to rainy weather."

"For the sake of comparison M. Montigny has calculated the relative frequency of colors in two stars of the second type. The stars selected were Pollux, with a very characteristic spectrum, and Capella, which scintillates with great regularity. Both stars are yellow and their spectra show very thin dark lines. The influence of the weather was equally apparent in these stars; in dry weather red was more frequent, and in rainy weather blue."

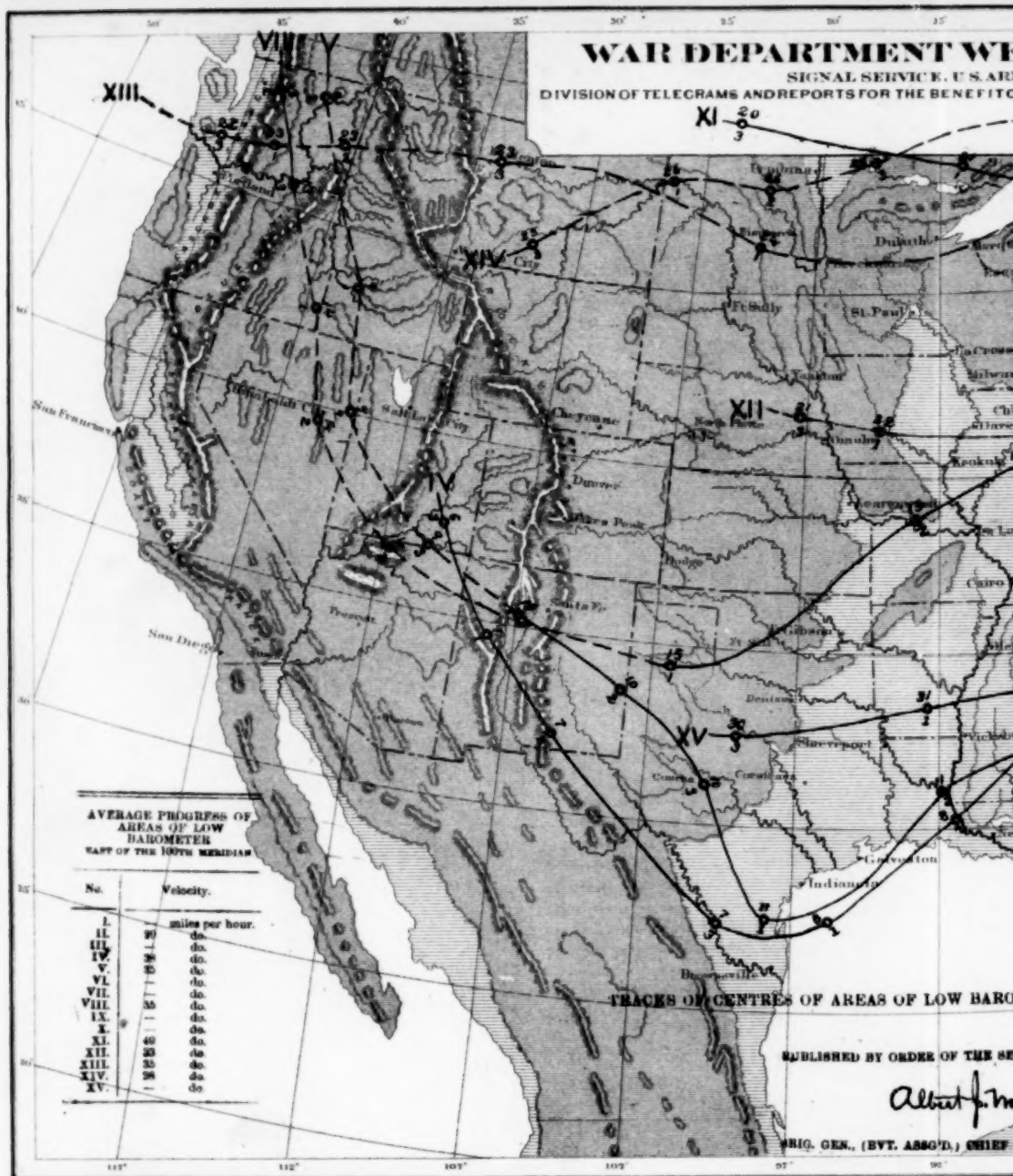
**Direction of motion of Cyclones.**—Mr. Eliot, meteorological reporter for the province of Bengal, announces that a cyclonic vortex, when generated in the middle of the Bay of Bengal, always travels towards that part of the coast where the wind velocity for the time being is least in comparison with the average velocity for the same place and time of year. This law has been verified by almost all the cyclonic disturbances that have occurred in the Bay since a chain of meteorological observatories was established round it, and it lends a great deal of support to the theory that a cyclonic vortex is developed through the accumulation, concentration, and condensation of aqueous vapor over a region of comparative calm.

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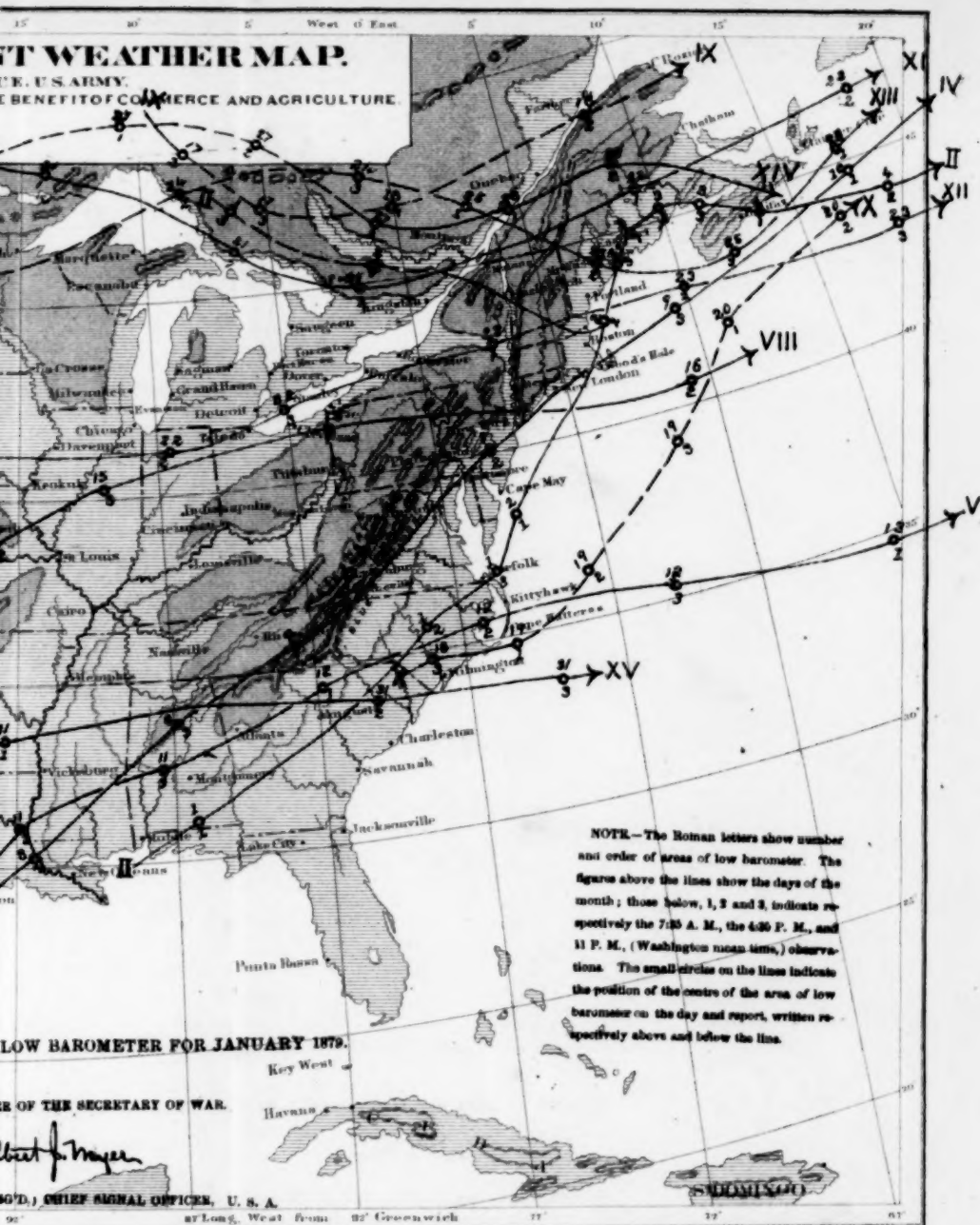
Albert J. Myers

Brig. Gen. (Bvt. Assg<sup>d</sup>.) Chief Signal Officer, U. S. A.

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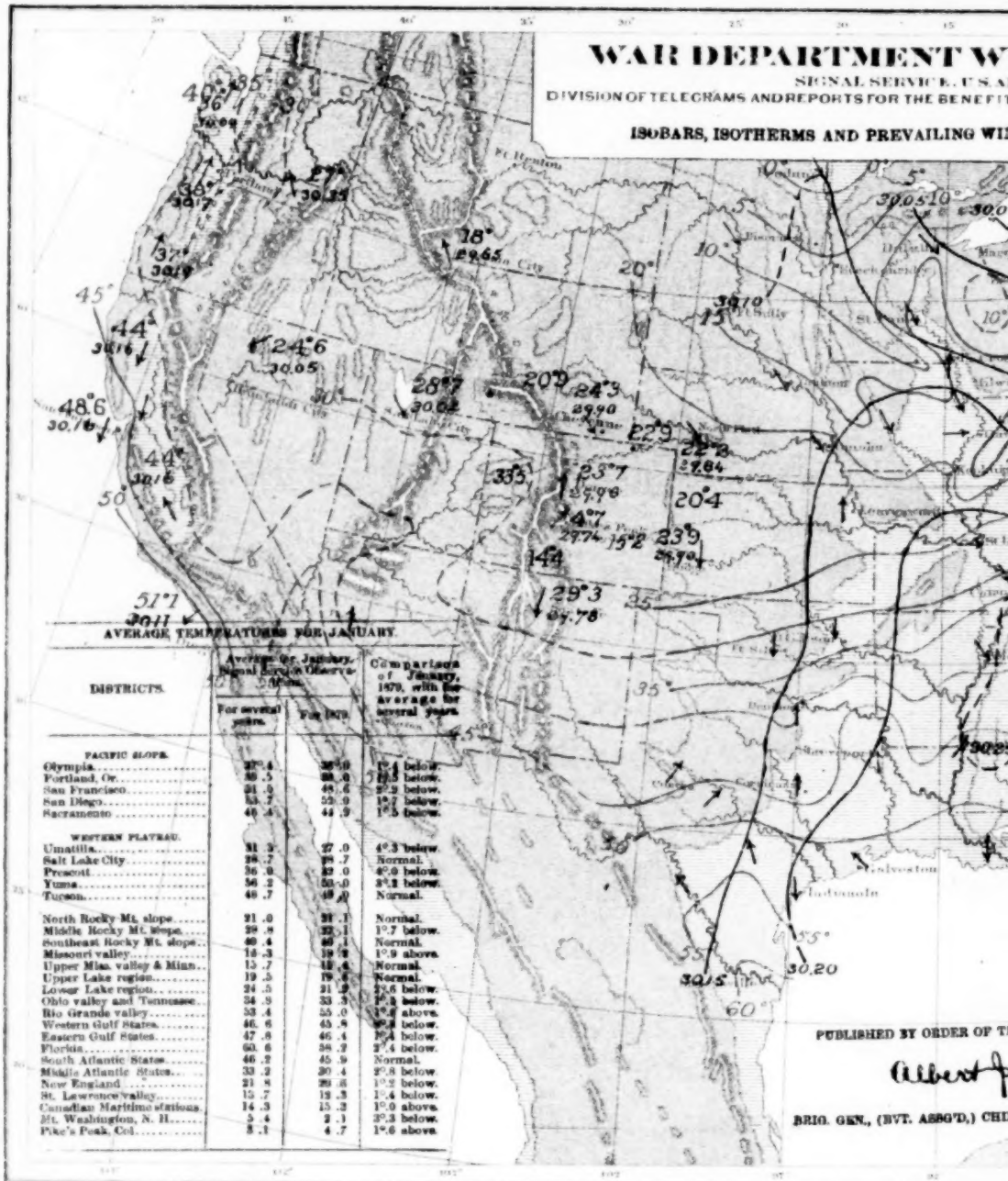


**WEATHER MAP.**  
U. S. ARMY.  
FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.



# WAR DEPARTMENT SIGNAL SERVICE, U.S. DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT

190BARS, ISOTHERMS AND PREVAILING WINDS



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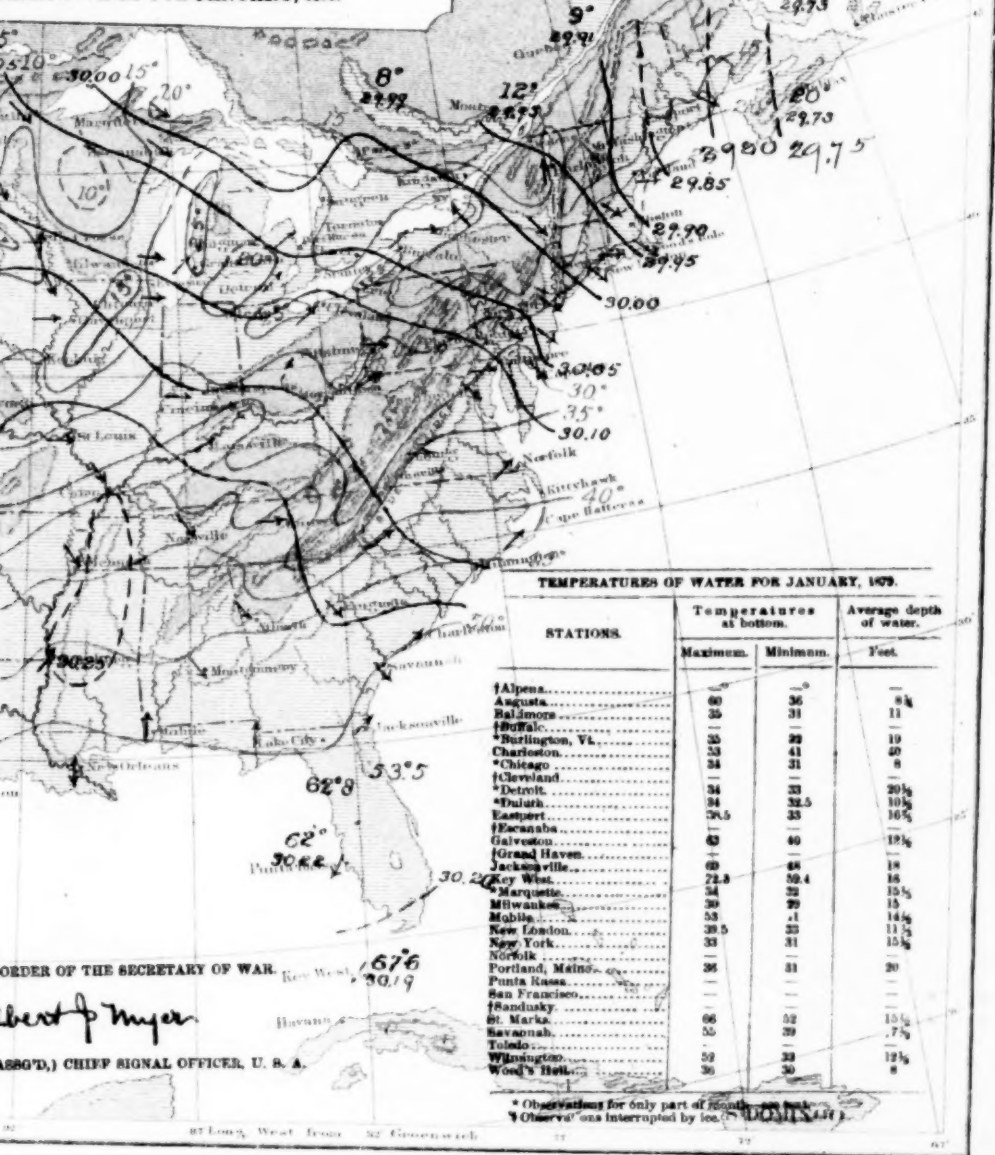
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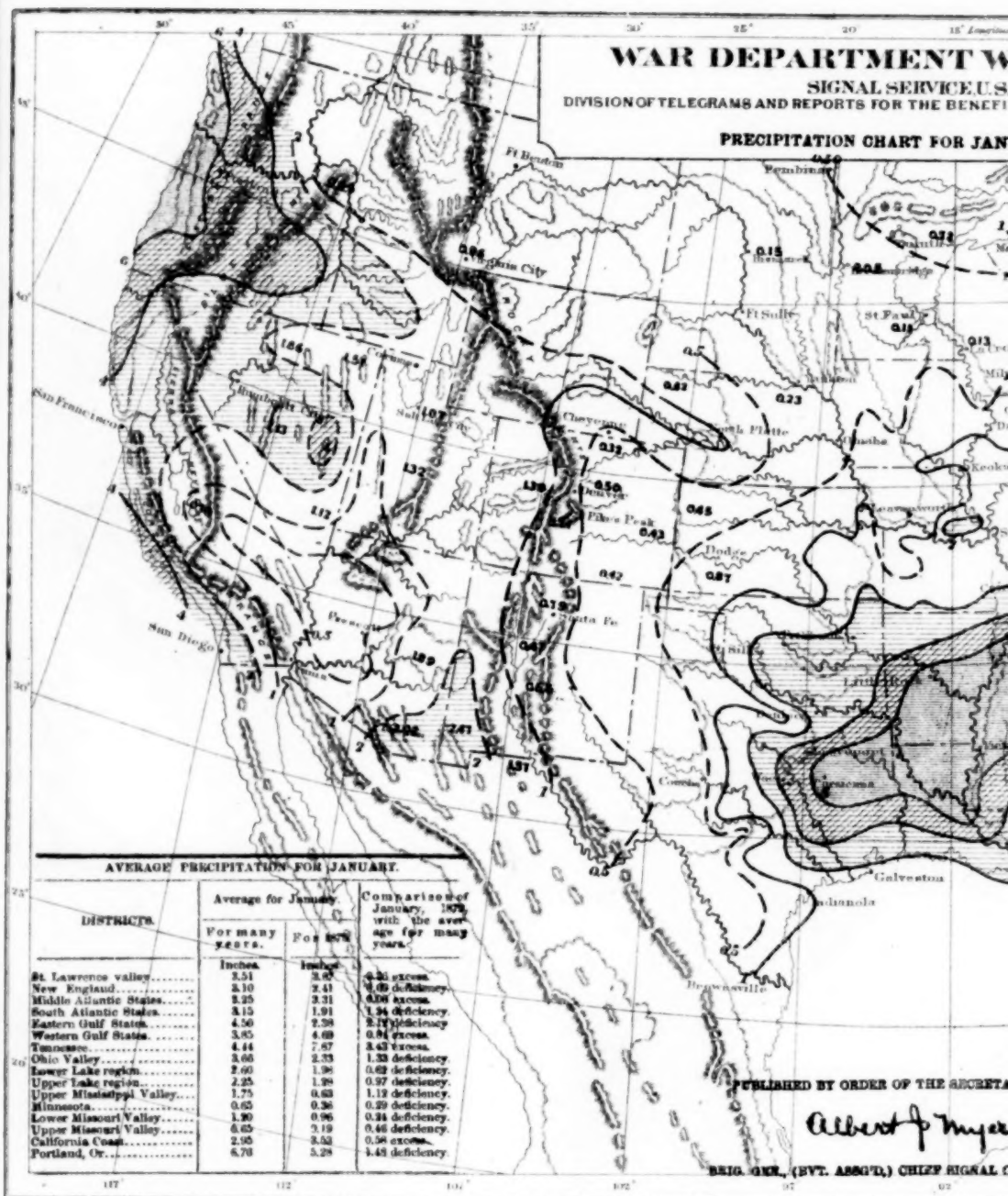
## NT WEATHER MAP.

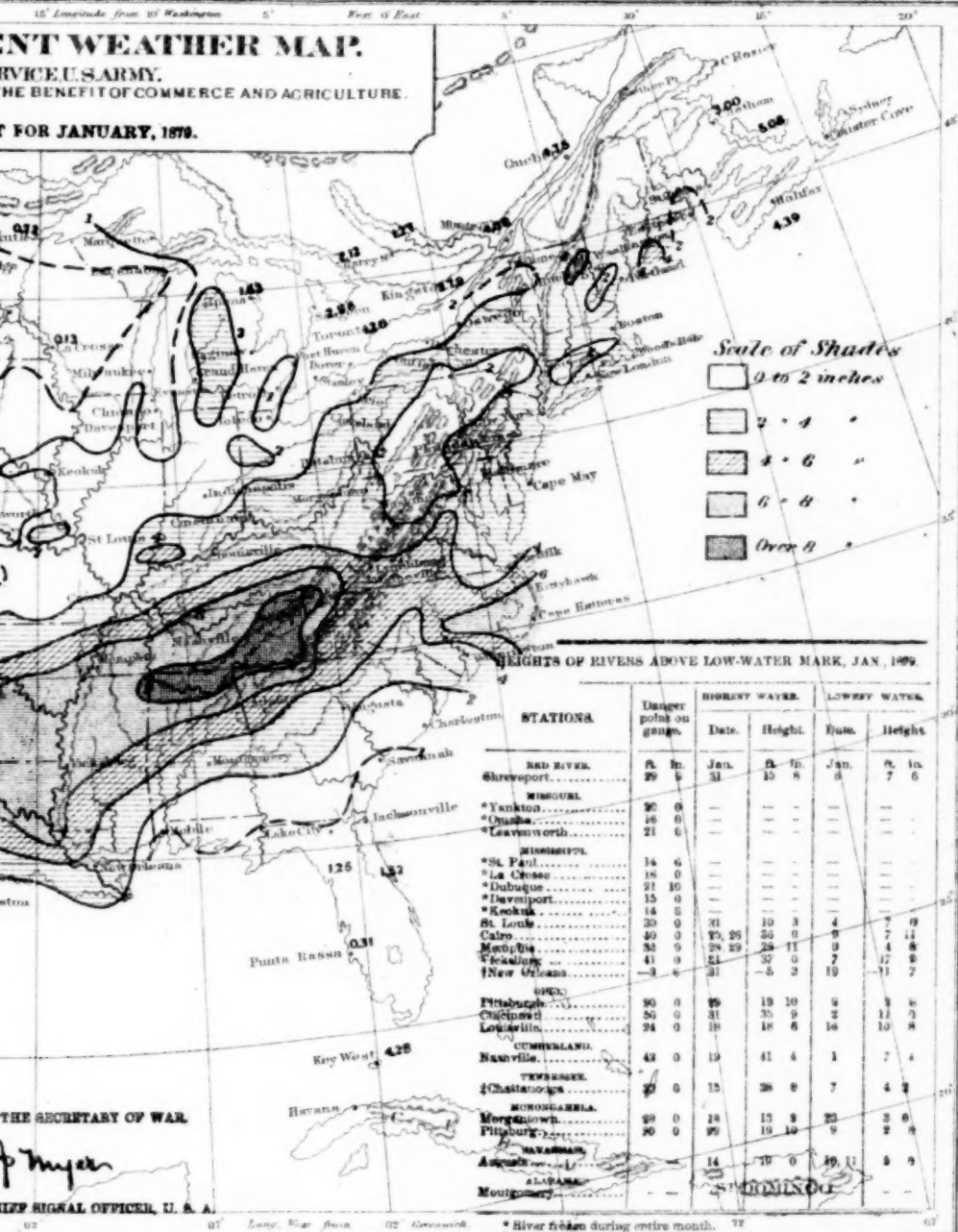
IN THE INTEREST OF THE U. S. ARMY.  
FOR THE BENEFIT OF COMMERCE AND AGRICULTURE

PREVAILING WINDS FOR JANUARY, 1879.



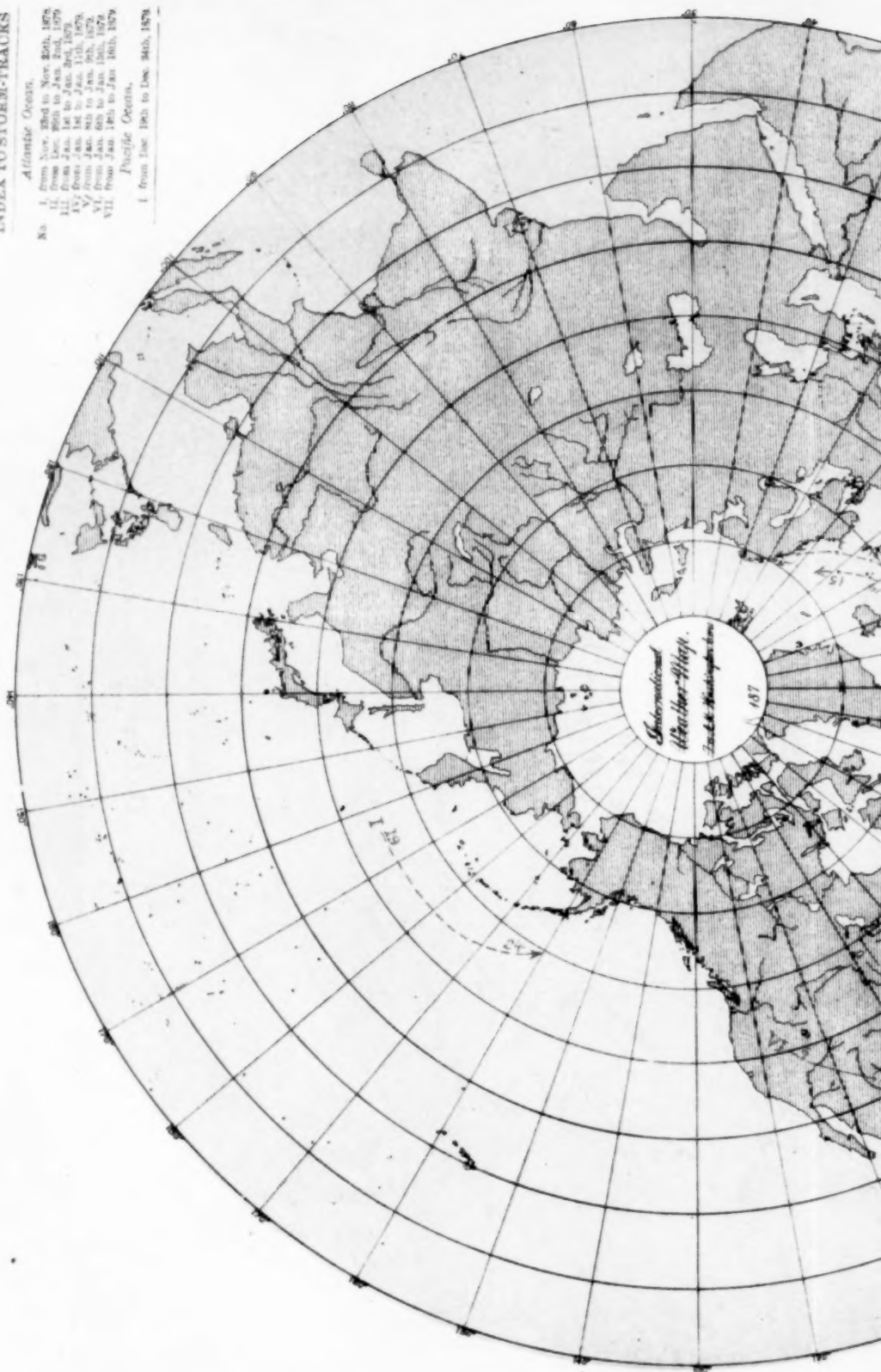
### PRECIPITATION CHART FOR JAN





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Atlantic Ocean.	
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	II. from Nov. 20th to Jan. 1st, 1879
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# INTERNATIONAL METEOROLOGY—OCEAN STORM-TRACKS

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

*Albert F. Meyer*

BRIG. GEN., (BVT. ASS'G'D.) CHIEF SIGNAL OFFICER, U. S. A.

Broken or dotted lines indicate that the lines so broken are doubtful.

Arrows, when charted, show the wind and exhibit wind-direction.

The tracks charted in black have appeared in previous *Reviews*.

The tracks charted in red have been made from data collected since preceding *Reviews*.

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